Introduction to the Special Issue on Innovative Applications of Artificial Intelligence

Bruce Porter and William Cheetham

■ We are very pleased to republish here extended versions of a sample of the papers drawn from the Innovative Applications of Artificial Intelligence Conference (IAAI-06), which was held July 17–20, 2006, in Boston, Massachusetts. Three of these articles describe deployed applications and two describe emerging applications.

One indication of the maturity and vitality of scientific research is its successful application to hard, real-world problems. By this measure, artificial intelligence is going strong. Evidence comes from the annual *Conference on Innovative Applications of Artificial Intelligence* (IAAI), the premier conference on AI applications. The papers presented at the conference provide compelling case studies of the value and impact of AI technology. We are very pleased to republish here extended versions of a sample of the papers drawn from IAAI-06, which was held July 17–20, 2006, in Boston, Massachusetts. Three of these papers describe deployed applications and two describe emerging applications.

Deployed Applications

The Innovative Applications of Artificial Intelligence Conference's highest honors go to those who have deployed a new AI application, which often requires overcoming many obstacles, both technical and organizational.

In the first deployed application, researchers at IBM applied AI methods to the task of verifying processors and systems ("Constraint-based Random Stimuli Generation for Hardware Verification" by Yehuda Naveh, Michal Rimon, Itai Jaeger, Yoav Katz, Michael Vinov, Eitan Marcus, and Gil Shurek). Their article describes an application of knowledge representation, expert systems, and constraint satisfaction to address the major bottleneck in the hardware design cycle: functional verification. The development required about a decade, but the payoff has already been substantial.

In the second application, Nestor Rychtyckyj of Ford Motor Company deployed a machine translation system to translate vehicle assembly instructions from English to a variety of other languages ("Machine Translation for Manufacturing: A Case Study at Ford Motor Company" by Nestor Rychtyckyj). The input to the translator is expressions in a nicely designed controlled language with a vocabulary of 5000 terms. The system has already translated over 5 million instructions, and it is an integral part of Ford's work in Europe, Mexico, and South America.

In the third application, Tuomas Sandholm of CombineNet, Inc., deployed a new tree search algorithm (and other technologies) to the richly complex problem of clearing auctions among sourcing professionals ("Expressive Commerce and Its Application to Sourcing: How We Conducted \$35 Billion of Generalized Combinatorial Auction" by Tuomas Sandholm). The approach allows preferences and constraints to be expressed in great detail, yet it efficiently finds win-win solutions for buyers and sellers. Sandholm reports the application has saved the auction participants \$4.4 billion.

World Trade Center Boston—Site of the 2006 Innovative Applications of Artificial Intelligence Conference.

Emerging Applications

The IAAI conference also recognizes creative applications of AI that have not yet been deployed but are on a promising path.

The first emerging application helps users find and visualize alternative plans for school redistricting ("Heuristic Search and Information Visualization Methods for School Redistricting" by Marie desJardins, Blazej Bulka, Ryan Carr, Eric Jordan, and Penny Rheingans). School redistricting is a hard optimization problem with numerous competing objectives. The goal of the application is to find a set of qualitatively different plans that highlight the trade-offs in the decision space.

The second application provides some protection to software systems vulnerable to attack ("AWDRAT: A Cognitive Middleware System for Information Survivability" by Howard Shrobe, Robert Laddaga, Bob Balzer, Neil Goldman, Dave Wile, Marcelo Tallis, Tim Hollebeck, and Alexander Egyed). The application uses a variety of AI techniques, including modeling and diagnosis, to enable software systems to continue functioning even after a successful attack, for example by recognizing the application's critical data that must be preserved in case of failure.

We hope you enjoy these exemplary articles and invite you to submit descriptions of your AI applications to the next IAAI conference.

Bruce Porter is a professor in the Department of Computer Science at the University of Texas at Austin and the director of the Artificial Intelligence Laboratory. His primary focus of research and teaching is knowledge systems and related topics such as knowledge representation, question answering, and explanation generation. Porter has served as the chair of the National Conference on Artificial Intelligence (2001) and cochair of the Innovative Applications of Artificial Intelligence conference (2005). He earned his Ph.D. in 1984 from the University of California at Irvine and received a Presidential Young Investigator award from the National Science Foundation in 1988.

William Cheetham is a senior researcher in the artificial intelligence laboratory of the General Electric Global Research Center in upstate New York, where he has worked since 1985. His job is to invent or improve knowledge-based products and services. This often involves the application of artificial intelligence and related techniques. He has led the development of more than a dozen intelligent systems that are in use throughout the General Electric Company. Since 1998, he has been an adjunct professor at Rensselaer Polytechnic Institute, where he now teaches the class Applied Intelligent Reasoning Systems.