EVENT REVIEW

Advances in Cognitive Informatics and Cognitive Computing:
Report on IEEE ICCI’08 at Stanford University

Yingxu Wang, University of Calgary, Canada
Jean-Claude Latombe, Stanford University, USA
Du Zhang, California State University, Sacramento, USA
Witold Kinsner, University of Manitoba, Canada

ABSTRACT

Cognitive informatics is the transdisciplinary study of cognitive and information sciences, which investigates the internal information processing mechanisms and processes of the natural intelligence – human brains and minds – and their engineering applications in computational intelligence. The 7th IEEE International Conference on Cognitive Informatics (ICCI 2008) has been organized at Stanford University during August 14-16, 2008. The ICCI’08 program covers a wide spectrum of topics that contribute to cognitive informatics. This report highlights the latest advances in cognitive informatics and cognitive computing presented in ICCI’08.

Keywords: Abstract Intelligence, Artificial Intelligence, Brain, Cognitive Computing, Cognitive Informatics, Computational Intelligence, Denotational Mathematics, ICCI, Natural Intelligence

INTRODUCTION

Cognitive Informatics (CI) is a cutting-edge and multidisciplinary research area that tackles the fundamental problems shared by computational intelligence, modern informatics, computer science, AI, cybernetics, cognitive science, neuropsychology, medical science, philosophy, formal linguistics, and life science. The development and the cross fertilization among the aforementioned science and engineering disciplines have led to a whole range of extremely interesting new research areas known as CI. CI is the transdisciplinary study of cognitive and information sciences, which investigates the internal information processing mechanisms...

The IEEE series of International Conference on Cognitive Informatics (ICCI) has been established since 2002 (Wang, 2002; Wang et al., 2002). Since its inception, ICCI has been growing steadily in its size, scope, and depth. It attracts worldwide researchers from academia, government agencies, and industry practitioners. The conference series provides a main forum for the exchange and cross-fertilization of ideas in the new research field of CI toward revealing the cognitive mechanisms and processes of human information processing and the approaches to mimic them in cognitive computing.

ICCI’08 is the seventh conference of the ICCI series held at Stanford University, California, USA, during August 14-16, 2008. The theme of ICCI’08 is Cognitive Computing and Computational Intelligence. The ICCI’08 program encompasses 56 regular papers with an acceptance rate of 48% based on rigorous reviews by program committee members and external reviewers. The structure of ICCI’08 consists of parallel sessions, keynotes, and a panel. The proceedings of ICCI’08 have been published by IEEE CS Press (Wang et al., 2008).

The ICCI’08 program covers a wide spectrum of topics that contribute to cognitive informatics and cognitive computing. A novel theory of abstract intelligence (αI) is reported (Wang, 2009; Wang et al., 2008), which is a form of driving force that transfers information into knowledge and behaviors. An architectural framework of abstract intelligence and the generic abstract intelligence mode (GAIM) are formally developed, which provide a unified theory for explaining the fundamental mechanisms of advanced intelligence and their denotational mathematical models of the paradigms of natural, artificial, machinable, and computational intelligence. During ICCI’08 researchers exchanged ideas on: a) Models of the natural intelligence such as logical brain models, cognitive mechanisms and processes, memory and learning, thinking and reasoning, computational consciousness, and neuropsychology; b) Internal information processing mechanisms such as cognitive informatics model of the brain, the object-attribute-relation (OAR) model of internal knowledge representation, autonomous machine learning, memorization processes, neural networks and neural computation, and visual pattern recognition; c) Denotational mathematics such as concept algebra, system algebra, process algebra, granular algebra, visual semantic algebra, fuzzy logic, fuzzy inferences, and fuzzy causality analyses; and d) Engineering applications of CI such as cognitive computers, autonomous agent systems, bioinformatic systems, visual object analyses and syntheses, and machine learning systems. ICCI’08 brought together a group of over 80 researchers and graduate students to report latest research results of CI and to explore new ideas in CI. Through stimulating discussions and a panel session on the future of cognitive informatics, the participants were excited about the current advances and the future trends in CI, which may lead to the development of next generation cognitive computers that think and feel (Wang, 2007, 2009; Wang et al., 2009b).

The ICCI’08 program is enriched by four distinguished keynotes, especially one presented by Prof. Lotfi A. Zadeh, University of California, Berkeley, as shown in Fig. 1. In his keynote on “Toward Human Level Machine Intelligence – Is it Achievable? (Zadeh, 2008)” Zadeh presented that achievement of human level machine intelligence has long been one of the basic objectives of AI. Since AI’s born in 1956, very impressive progress has been made in many areas, but not in the realm of human level machine intelligence and no machine can pass the Turing test. Humans have many remarkable capabilities; two of them stand out in importance. First, the capability to reason, converse and make rational decisions in an
environment of imprecision, uncertainty, and incompleteness of information. And second, the capability to perform a wide variety of physical and mental tasks without any measurement and computation. A prerequisite to achieve human level machine intelligence is mechanization of these capabilities and, in particular, mechanization of natural language understanding. To make progress toward achievement of human level machine intelligence, AI must add to its armamentarium concepts and techniques drawn from other methodologies, especially evolutionary computing, neurocomputing, and fuzzy logic. The machinery may contribute to AI toward the achievement of human level machine intelligence and its applications in decision making, pattern recognition, as well as diagnosis and assessment of causality.

As interesting as Zadeh’s distinguished speech, the other three keynote speeches addressed the following key issues in CI (Wang et al., 2008). Jean-Claude Latombe, Professor of Stanford University, presented the keynote on “Probabilistic Roadmaps: an Incremental Sampling Approach to Approximate the Connectivity of Robot Configuration Spaces.” Yingxu Wang, Professor of University of Calgary, presented the keynote “On Abstract Intelligence and Its Denotational Mathematics Foundations.” Witold Kinsner, Professor of University of Manitoba, presented the keynote on “Complexity and Its Measures in Cognitive and Other Complex Systems.”

Participants of ICCI’08 have witnessed exciting results from the exploration of many perspectives of CI. The research interest on CI all over the world is growing rapidly and the
core body of knowledge produced thus far is taking shape in both quality and quantity. Further information about CI may be found at http://enel.ucalgary.ca/ICCI2008/. The ICCI Steering Committee welcomes contributions and suggestions from researchers around the world in planning future events. Multidisciplinary researchers and practitioners are invited to join the CI community and participate in the future conferences in the IEEE ICCI series.

ACKNOWLEDGMENT

The ICCI’08 program as presented in the proceedings is the result of the great effort and contributions of many people. We would like to thank all authors who submitted interesting papers to ICCI’08. We acknowledge the professional work of the program committee and external reviewers for their effective review and improvement of the quality of submitted papers. Our acknowledgement goes to the invaluable sponsorships of IEEE Computer Society, The IEEE ICCI Steering Committee, and IEEE CS Press, as well as International Journal of Cognitive Informatics and Natural Intelligence (IJCINI), and International Journal of Software Science and Computational Intelligence (IJSSCI). We would express our sincere appreciation to the keynote speakers, particularly Prof. Lotfi A. Zadeh, for presenting their visions and insights on fostering this emerging interdisciplinary area of CI. We acknowledge the organizing committee members, particularly the ICCI’08 secretariats and student volunteers, who have helped to make the event a success.

REFERENCES


