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IFIP – The International Federation for Information Processing

IFIP was founded in 1960 under the auspices of UNESCO, following the First World Computer Congress held in Paris the previous year. An umbrella organization for societies working in information processing, IFIP's aim is two-fold: to support information processing within its member countries and to encourage technology transfer to developing nations. As its mission statement clearly states,

> *IFIP's mission is to be the leading, truly international, apolitical organization which encourages and assists in the development, exploitation and application of information technology for the benefit of all people.*

IFIP is a non-profitmaking organization, run almost solely by 2500 volunteers. It operates through a number of technical committees, which organize events and publications. IFIP's events range from an international congress to local seminars, but the most important are:

- The IFIP World Computer Congress, held every second year;
- Open conferences;
- Working conferences.

The flagship event is the IFIP World Computer Congress, at which both invited and contributed papers are presented. Contributed papers are rigorously refereed and the rejection rate is high.

As with the Congress, participation in the open conferences is open to all and papers may be invited or submitted. Again, submitted papers are stringently refereed.

The working conferences are structured differently. They are usually run by a working group and attendance is small and by invitation only. Their purpose is to create an atmosphere conducive to innovation and development. Refereeing is also rigorous and papers are subjected to extensive group discussion.

Publications arising from IFIP events vary. The papers presented at the IFIP World Computer Congress and at open conferences are published as conference proceedings, while the results of the working conferences are often published as collections of selected and edited papers.

Any national society whose primary activity is about information processing may apply to become a full member of IFIP, although full membership is restricted to one society per country. Full members are entitled to vote at the annual General Assembly, National societies preferring a less committed involvement may apply for associate or corresponding membership. Associate members enjoy the same benefits as full members, but without voting rights. Corresponding members are not represented in IFIP bodies. Affiliated membership is open to non-national societies, and individual and honorary membership schemes are also offered.

Zhongzhi Shi Zhaohui Wu David Leake
Uli Sattler (Eds.)

Intelligent Information Processing VII

8th IFIP TC 12 International Conference, IIP 2014
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Proceedings

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Preface

This volume comprises the 8th IFIP International Conference on Intelligent Information Processing. As the world proceeds quickly into the Information Age, it encounters both successes and challenges, and it is well recognized nowadays that intelligent information processing provides the key to the Information Age and to mastering many of these challenges. Intelligent information processing supports the most advanced productive tools that are said to be able to change human life and the world itself. However, the path is never a straight one and every new technology brings with it a spate of new research problems to be tackled by researchers; as a result we are not running out of topics; rather the demand is ever increasing. This conference provides a forum for engineers and scientists in academia, university, and industry to present their latest research findings in all aspects of intelligent information processing.

This is the 8th IFIP International Conference on Intelligent Information Processing. We received more than 70 papers, of which 32 papers are included in this program as regular papers and 3 as short papers. We are grateful for the dedicated work of both the authors and the referees, and we hope these proceedings will continue to bear fruit over the years to come. All papers submitted were reviewed by two referees.

A conference such as this cannot succeed without help from many individuals who contributed their valuable time and expertise. We want to express our sincere gratitude to the Program Committee members and referees, who invested many hours for reviews and deliberations. They provided detailed and constructive review reports that significantly improved the papers included in the program.

We are very grateful to have the sponsorship of the following organizations: IFIP TC12, Zhejiang University and Institute of Computing Technology, Chinese Academy of Sciences. Thanks to Dr. Xi Yang for carefully checking the Proceedings.

Finally, we hope you find this volume inspiring and informative. Enjoy your leisurely stay in Hangzhou, China.

August 2014

Zhongzhi Shi
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Abstracts of Keynote Presentations

Challenges of Big Data in Scientific Discovery

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Abstract. Big Data is emerging as one of the hottest multi-disciplinary research fields in recent years. Big data innovations are transforming science, engineering, medicine, healthcare, finance, business, and ultimately society itself. In this presentation, we examine the key properties of big data (volume, velocity, variety, and veracity) and their relation to some applications in science and engineering. To truly handle big data, new paradigm shifts (as advocated by the late Dr. Jim Gray) will be necessary. Successful applications in big data will require in situ methods to automatically extracting new knowledge from big data, without requiring the data to be centrally collected and maintained. Traditional theory on algorithmic complexity may no longer hold, since the scale of the data may be too large to be stored or accessed. To address the potential of big data in scientific discovery, challenges on data complexity, computational complexity, and system complexity will need to be solved. We illustrate these challenges by drawing on examples in various applications in science and engineering.

Neuromorphic Computing beyond von Neumann

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Abstract. The brain is characterized by extreme power efficiency, fault tolerance, compactness and the ability to develop and to learn. It can make predictions from noisy and unexpected input data. Any artificial system implementing all or some of those features is likely to have a large impact on the way we process information.

With the increasingly detailed data from neuroscience and the availability of advanced VLSI process nodes the dream of building physical models of neural circuits on a meaningful scale of complexity is coming closer to realization. Such models deviate strongly from classical processor-memory based numerical machines as the two functions merge into a massively parallel network of almost identical cells.

The lecture will introduce current projects worldwide and introduce the approach proposed by the EU Human Brain Project to establish a systematic path from biological data, simulations on supercomputers and systematic reduction of cell complexity to derived neuromorphic hardware implementations with a very high degree of configurability.

Ontology-Based Monitoring of Dynamic Systems

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Abstract. Our understanding of the notion "dynamic system" is a rather broad one: such a system has states, which can change over time. Ontologies are used to describe the states of the system, possibly in an incomplete way. Monitoring is then concerned with deciding whether some run of the system or all of its runs satisfy a certain property, which can be expressed by a formula of an appropriate temporal logic.

We consider different instances of this broad framework, which can roughly be classified into two cases. In one instance, the system is assumed to be a black box, whose inner working is not known, but whose states can be (partially) observed during a run of the system. In the second instance, one has (partial) knowledge about the inner working of the system, which provides information on which runs of the system are possible. In this talk, we will review some of our recent research that investigates different instances of this general framework of ontology-based monitoring of dynamic systems.

Cyborg Intelligence: Towards the Convergence of Machine and Biological Intelligence

Zhaohui Wu

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Abstract. Recent advances in the multidisciplinary fields of brain-machine interfaces, artificial intelligence, computational neuroscience, microelectronics, and neurophysiology signal a growing convergence between machines and living beings. Brain-machine interfaces (BMIs) enable direct communication pathways between the brain and an external device, making it possible to connect organic and computing parts at the signal level. Cyborg means a biological-machine system consisting of both organic and computing components. Cyborg intelligence aims to deeply integrate machine intelligence with biological intelligence by connecting machines and living beings via BMIs, enhancing strengths and compensating for weaknesses by combining the biological cognition capability with the machine computational capability. This talk will introduce the concept, architectures, and applications of cyborg intelligence. It will also discuss issues and challenges.

EEG-Based Visual Brain-Computer Interfaces

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Abstract. Over the past several decades, electroencephalogram (EEG) based brain-computer interfaces (BCIs) have attracted attention from researchers in the field of neuroscience, neural engineering, and clinical rehabilitation. While the performance of BCI systems has improved, they do not yet support widespread usage. Recently, visual BCI systems have become popular because of their high communication speeds, little user training, and low user variation. However, it remains a challenging problem to build robust and practical BCI systems from physiological and technical knowledge of neural modulation of visual brain responses. This talk will review the current state and future challenges of visual BCI systems. And the taxonomy based on the multiple access methods of telecommunication systems is described. Meanwhile, the challenges will be discussed, i.e., how to translate current technology into real-life practices. Specifically, useful guidelines are provided in this talk to help exploring new paradigms and methodologies to improve the current visual BCI technology.

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