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Andrei Voronkov · Irina Virbitskaite (Eds.)

Perspectives of System Informatics

9th International Ershov Informatics Conference,
PSI 2014

St. Petersburg, Russia, June 24–27, 2014

Revised Selected Papers

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Preface

This volume contains the papers presented at PSI 2014: 9th Ershov Informatics Conference held during June 24–27, 2014 in St. Petersburg, Russia.

PSI is the premier international forum in Russia for academic and industrial researchers, developers, and users working on topics relating to computer, software, and information sciences. The conference serves to bridge the gaps between different communities whose research areas are covered by but not limited to foundations of program and system development and analysis, programming methodology, and software engineering and information technologies.

The previous eight PSI conferences were held in 1991, 1996, 1999, 2001, 2003, 2006, 2009, and 2011, respectively, and proved to be significant international events. Traditionally, PSI offers a program of keynote lectures, presentations of contributed papers, and workshops complemented by a social program reflecting the amazing diversity of the Russian culture and history.

The PSI conference series is dedicated to the memory of the pioneer in theoretical and system programming research: academician Andrei Petrovich Ershov (1931–1988). Andrei Ershov graduated from the Moscow State University in 1954. He began his scientific career under the supervision of Alexandr Lyapunov. After that Andrei Ershov worked at the Institute of Precise Mechanics and Computing Machinery, and then became director of the Theoretical Programming Department at the Computing Center of the USSR Academy of Sciences in Moscow. In 1958 the Department was reorganized into the Institute of Mathematics of the Siberian Branch of the USSR Academy of Sciences, and by the initiative of the academician Sergei Sobolev Ershov was appointed the head of this department, which later became part of the Computing Center in Novosibirsk Akademgorodok. The first significant project of the Department was aimed at the development of the ALPHA system, an optimizing compiler for an extension of Algol 60 implemented on a Soviet computer M-20. Later the researchers of the Department created the Algibr, Epsilon, Sigma, and Alpha-6 programming systems for the BESM-6 computers. The list of achievements also include the first Soviet time-sharing system AIST-0, the multi-language system BETA, research projects in artificial intelligence and parallel programming, integrated tools for text processing and publishing, and many more. A.P. Ershov was a leader and a participant of these projects. In 1974 he was nominated Distinguished Fellow of the British Computer Society. In 1981 he received the Silver Core Award for services rendered to IFIP. Andrei Ershov's brilliant speeches were always in the focus of public attention. Especially notable was his lecture on "Aesthetic and Human Factor in Programming" presented at the AFIPS Spring Joint Computer Conference in 1972.

This edition of the conference attracted 80 submissions from 29 countries. We wish to thank all their authors for their interest in PSI 2014. Each submission was reviewed by three experts, at least two of them from the same or closely related discipline as the authors. The reviewers generally provided high-quality assessment of the papers and

often gave extensive comments to the authors for possible improvement of their contributions. As a result, the Program Committee has selected for presentation at the conference 17 high-quality papers as regular talks, 11 papers as short talks, and 2 papers as system and experimental talks. A range of hot topics in computer science and informatics is covered by five keynote talks given by prominent computer scientists from various countries.

We wish to express our gratitude to all the persons and organizations who contributed to the conference: the authors of all the papers for their effort in producing the materials included here; the sponsors for their moral, financial, and organizational support; the Steering Committee members for their coordination of the conference, the Program Committee members and the reviewers who did their best to review and select the papers, and the members of the Organizing Committee for their contribution to the success of this event and its great cultural program.

The Program Committee work was done using the EasyChair conference management system.

December 2015

Andrei Voronkov
Irina Virbitskaite

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The Laws of Concurrent Programming

(Abstract)

Tony Hoare

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At the beginning of my academic career (1968), I wanted to express the axioms of sequential computer programming in the form of algebraic equations. But I did not know how. Instead I formalised the axioms as deduction rules for what became known as Hoare logic.

I now know how I should have done it as an algebra. Furthermore, I can add a few neat axioms that extend the algebra to concurrent programming. From the axioms one can prove the validity of the structural proof rules for Hoare logic, as extended to concurrency by separation logic. Furthermore, one can prove the deductive rules for an operational semantics of process algebra, expressed in the style of Milner. In fact, there is an algebraic time-reversal duality between the two forms of semantic rule. For me, this was a long-sought unification.

Big Data, Big Systems, Big Challenges: A Personal Experience

(Extended abstract)

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I have been fortunate to work in two remarkable research communities, Akademgorodok in Siberia and Silicon Valley in California, and that my professional career stretched over two very different, yet both exciting epochs of the computer systems and science evolution: steady accumulation of knowledge and technology in 1960s–1980s and, then, “Internet Big Bang” and Information Revolution in 1990s–2010s.

In this talk, I track the trends in the development of large computer systems which I witnessed working first at Hewlett-Packard Laboratories and then at Carnegie-Mellon University, Silicon Valley Campus. This is not a general survey, I exemplify those trends by the systems in the analysis or/and design of which I and my colleagues participated.

The driving force behind the computer system progress is unprecedented accumulation of complex data and huge global data traffic. “Big Data” is a popular metaphor labeling the situation. It becomes difficult to process Big Data using traditional computer systems and applications. “Big Systems” that become the main trend in the current system architecture are required. They include: powerful data centers using tens of thousands servers; enterprise IT “systems of systems” consisting of globally distributed data centers; Grid and Utility Computing; Cloud Computing; Warehouse Scale Computers, Internet of Things (IoT), and coming exascale supersystems.

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