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Performance Evaluation of Computer and Communication Systems

Milestones and Future Challenges

IFIP WG 6.3/7.3 International Workshop, PERFORM 2010
in Honor of Günter Haring
on the Occasion of His Emeritus Celebration
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Preface

Professor Emeritus Dr. Günter Haring.

Günter Haring has dedicated most of his scientific professional life to performance evaluation and the design of distributed systems, contributing in particular to the field of *workload characterization*. To honor Günter Haring on the occasion of his emeritus celebration, some of the key researchers in the field of performance evaluation were invited to reflect on *Performance Evaluation of Computer and Communication Systems – Milestones and Future Challenges* at the PERFORM 2010 workshop, held during October 14–16, in Vienna, Austria.

PERFORM 2010 aimed at bringing together renowned experts and world leaders in the field of networked systems and performance evaluation not only to review historical milestones, but also to discuss their impact on current and future developments as well as to identify novel, inspiring, and visionary concepts in performance evaluation and future complex networked systems. The reflection on milestones and impacts is particularly timely when thinking about novel

emerging technologies such as the Internet of Things, heterogeneous wireless network infrastructures, and socio-technical distributed systems. The contributions presented at PERFORM 2010 and collected in this book demonstrate the strong history of, but also new research directions in, performance evaluation.

The contributions of Günter Haring himself to the field of performance evaluation and distributed systems are manifold as reflected by over 150 publications. His structured way applied to workload characterization led to well-known approaches on how to hierarchically decompose workload by a multi-layer approach, on how to introduce task level descriptions, and on how to apply Markov models to describe the properties of task sequences. In addition to his own contributions and leadership in international research projects, he is and has been an excellent mentor of young researchers demonstrated by their own brilliant scientific careers. It is most admirable that Günter Haring has not only concentrated on his own research, but has also promoted computer science as a pioneer in Austria by – to mention only a few of his achievements – taking the responsibility of being the president of the Austrian Computer Society (1989–1993), being a founding member of the Austrian Center of Parallel Computing (ACPC), and being the founder and first dean of the Faculty for Computer Science at the University of Vienna (2004–2009).

Upon our invitation to contribute to PERFORM 2010, we were glad to accept 20 papers ranging from visionary to in-depth research articles. To assure high quality, the papers were reviewed by a minimum of two referees of the international Technical Program Committee. Upon the recommendation of the referees we introduced the process of supervised adaptation to four papers (shepherding). The strong technical program of PERFORM 2010 is reflected in the sections of this book.

By focusing on "Milestones and Evolutions," Raymond A. Marie opens the discussion about lessons learned in the past of performance evaluation as seen from an expert who contributed, for example, with methods for general queuing networks in the late 1970s. Connie Smith, co-author of a fundamental book on software performance engineering and well-known expert in the area, focuses together with Catalina M. Lladò on model interoperability. From a historical and evolutionary perspective, Giuseppe Serazzi, an expert in workload characterization, bottleneck detection in very large multi-class models, and tools for analyzing the performance of complex systems, and his co-authors Giuliano Casale and Marco Gribaudo give a summary of performance evaluation tools.

Novel challenges for performance evaluation are introduced by the contributions to the section "Trends: Green ICT and Virtual Machines." Jean-Marc Pierson, one of the pioneering European researchers investigating energy efficiency in distributed systems, highlights the importance of including energy as a new criterion to performance evaluation and proposes ways to approach modeling of energy efficiency. Ramon Puigjaner, who contributed with his expertise in performance evaluation in various application domains such as, for example, by the successful sizing of the central computer and communication network during the Olympic games in Barcelona, 1992, and his colleague Carlos Juiz,

an expert in performance analysis of Web-based systems, draw the connection from established methods of performance evaluation to "green ICT" demands. Another trend of networked systems, virtualization, is targeted by the predictive scheduling approach of Robert Geist, an expert in performance evaluation of disk scheduling and perception-based measures, and his co-authors Zachary H. Jones, and James Westall.

As "Modeling" is a key aspect in performance evaluation, five profound contributions focus on modeling details. Hermann de Meer, co-author of one of the fundamental books on queuing theory, and his colleagues Patrick Wüchner and Jànos Sztrik introduce finite-source retrial queues for modeling Wireless Sensor Networks. Markov chains and spectral clustering is the topic of the contribution of William J. Stewart, an expert in numerical solution of Markov chains and author of two books on Markov chains, and his co-author Ning Liu. Demetres D. Kouvatsos, who contributed to the field of performance evaluation with results in, for example, entropy maximization, queuing network models, and performance engineering applications, and his co-author Salam A. Assis focus on the analysis of heavy-tailed queues. Hidden Markov models and their use in performance evaluation are discussed by Edmundo de Souza e Silva, Rosa M.M. Leão, and Richard R. Muntz. In this article, the expertise of Edmundo de Souza e Silva, who developed fundamental solution techniques for Markov models, and Rosa M.M. Leão is brought together with the expertise of Richard R. Muntz, who developed pioneering contributions to the theory of queuing networks. Ioannis Stavrakakis, a well-known expert in network analysis research who contributed to various domains of computer networks including recently delay-tolerant networks, proposes the exploitation of linear properties of infinite dimensional linear equations for network protocol performance analysis.

"Mobility and Mobile Networks" are topics of ever-increasing interest as many novel networked services are intended for mobile use. Marco Conti, Andrea Passarella, and Chiara Boldrini, experts in the new field of research on social networks and opportunistic computing, introduce a novel modeling approach for socially aware forwarding schemes. Using mobility information, Vicente Casares-Giner proposes a general formulation of lookahead strategies for location updates in his article which reflects his expertise in applying and using mobility modeling in wireless networking. Concentrating on their expertise in reliability analysis of cellular networks, Fabio Ricciato, Peter Romirer-Maierhofer, and Angelo Coluccia propose a Bayesian estimation of mean failure probabilities in 3G networks. Markus Fiedler, an expert in Quality of Experience and teletraffic modeling, and his co-authors Patrik Arlos, Timothy A. Gonsalves, Anuraag Bhardwaj, and Hans Nottehed detail Web response times in mobile networks.

In the field of general "Communication and Computer Networks," two contributions focus on different aspects and different types of networks. Michal Pióro, who co-authored a widely recognized book on network traffic and network protocol decisions and whose research contributions include traffic modeling, analysis and optimization of communication networks, and his co-authors Walid Ben-Ameur and Pablo Pavon-Marino detail traffic domination in communication networks.

Monique Becker, an expert in evaluating the performance of aggregation techniques in computer networks, and her colleagues Ashish Gupta, Michel Marot, and Harmeet Singh present a summary of their works on clustering in wireless sensor networks.

Finally, "Load Balancing, Analysis, and Management" approaches are presented. Gabriele Kotsis, an expert in workload characterization in parallel and distributed systems, and her colleague Martin Pinzger use analysis insights to manage Web performance in a proactive way. Maria Carla Calzarossa, an expert in workload characterization and benchmarking of complex systems and services, and her co-author Luisa Massari focus on the analysis of Web logs. John C.S. Liu, who contributed to the field of performance analysis by stochastic analysis of computer storage and peer-to-peer systems, and his co-authors Guanlin Lin and Yang Wang present work on a matrix-analytic solution to randomized load balancing.

The technical program of PERFORM 2010 was completed by three additional talks given by Martin Reiser, Alois Ferscha, and Kurt Tutschku. Martin Reiser, inventor of mean value analysis of queuing networks, gave a lively talk entitled "Mean Value Analysis – A Personal Account." Alois Ferscha, who was among the pioneers of proposing a structured way of performance analysis of parallel simulations and, at present, contributes to the field of Pervasive Computing, gave an inspiring talk about "Scenario-Based Modeling for Very Large Scale Simulations." Kurt Tutschku discussed his new concepts and contributions to the challenging field of "Performance Requirements for Future Virtualized and Federated Networks."

Our thanks go to all authors and speakers, and further to the referees for their support in reviewing in spite of busy schedules and in particular to our shepherds for their tireless mentoring support. Many thanks go to Gerry Schneider and his team at the University of Vienna for supporting the event management. We are especially thankful for the support of the organizing team: Andrea Hess for producing the layout and printed content of the workshop program and Shelley Buchinger for organizing the marvelous wine-tasting as one of the social events of the workshop. Many thanks also go to Ewald Hotop and Rudolf Hürner for technical support and producing a nice photo gallery. For precise technical editing support of this book, special thanks go to Andrea Hess. And, finally, we want to thank Günter Haring, not only for always being an encouraging mentor but also for giving us the opportunity to meet his exceptional colleagues and friends at this scientific emeritus celebration.

Thank you and cordial congratulations, Günter Haring!

October 2010

Karin Anna Hummel
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Organization

PERFORM 2010, the Workshop on Performance Evaluation of Computer and Communication Systems – Milestones and Future Challenges, was organized by the Distributed Systems Group, University of Vienna, October 14–16, 2010.

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