

Performance Evaluation – Stories and Perspectives

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PREFACE

Increasing the performance was and is one of the driving forces in the development of computer and communication systems. Significant developments in hardware and software technology give us nowadays the computing speed of the supercomputers of 1990 in our desktop machines, gaming consoles surpass without any effort the computing power of the first generations of personal computers. Hardware and software vendors argue and compete against each other citing the performance of their systems in benchmark results.

But how can performance be defined? What are representative performance indicators allowing a valid comparison of systems? What methods are available to describe, model, and measure the performance of a system? Performance evaluation is a field of research which tries to find answers to those and related questions. Based on seminal work dating back now more than 30 years, performance evaluation has now matured into a discipline where a variety of analysis techniques and tools are available based on a solid theory.

This book is a collection of papers which have been presented at a symposium on performance evaluation uniting some of the key researchers in the field. Apart from the fact that the performance evaluation community always likes to meet and discuss and reflect latest trends and issues in research, there was a specific and very pleasant reason for organizing this event: Our colleague, mentor, and friend, Günter Haring, is celebrating his 60th birthday these days and has invited us for his birthday party. Having dedicated most of his “research life” to performance evaluation, he suggested to organize this symposium. It was a pleasure and honor for me to assist him in the planning and specifically to edit this book. Initially, we planned for a one day event with the birthday party in the evening. When I sent out my invitations, I was honestly overwhelmed by the positive feedback I received from all of you and it soon became clear that the program will fill two full days!

If I look now at the table of contents, I am very excited to meet all of you at the symposium in Vienna and to hear about your retrospectives of past developments as well as your perspectives for the future. The contributions cover a broad variety of topics in performance evaluation and illustrate beyond their technical contributions also the discipline and community itself.

Domenico Ferrari, famous among others for his seminal books on performance evaluation (the “white volume” and the “red volume”), will open the program with “Insularities Revisited” a paper in which he analyses the discipline of performance evaluation itself. Jeff Buzen, demonstrates in his paper on “Milestones in the Evolution of BEST/1®” a successful strategy for tool development. Edmundo de Souza e Silva also studies the evolution of evaluation methods and the appropriate tool support within the TANGRAM environment. The next two papers address simulation techniques.

Alois Ferscha was among the first researchers systematically investigating the performance of parallel simulation strategies. In his paper he summarizes the key findings in this area. Hisashi Kobayashi presents in his paper another approach to speed up simulation, namely importance sampling, which can reduce the simulation run time by as much as several orders of magnitude. Queueing theory has been extensively used since 70’s to carry out performance evaluations of complex computer systems.

Giuseppe Serazzi presents in his paper a technique for bottleneck analysis which allows for the solution of very large models involving multiple classes and several tens thousands of stations. Also the next paper, authored and presented by Harry Perros, is dedicated to queueing theory, weaving a lot of personal experience in the presentation of solution techniques for open QNMs with blocking. Peter Harrison contributes to this volume a paper on a novel, compositional approach based on process algebras to deriving the equilibrium state probabilities in separable Markov processes, while William Stewart presents the state of the art in the numerical approach to Markov chain modeling. Raymond Marie proposes recurrent stable expressions as analysis technique and applies this method successfully in three problem instances.

The next three papers all address the embedding of performance evaluation into computer and software system development. Ulrich Herzog picks up the topic of insularities and reflects on his research work “from Norton to performance enhanced specifications”. Ramon Puigjaner described different forms of tackling MASCOT designs for estimating their performance establishing new ways of communication between the functional designer and the performance analyst. Connie Smith, who coined the term “software performance engineering”, reports on this software-oriented, model-based approach.

With the following three papers we are entering the area of network performance evaluation. Carey Williamson investigates the question whether can we improve the performance of the TCP/IP protocols by creating “protocol awareness”, i.e. telling them what they are and what kind of network they are using. Monique Becker discusses in her contribution in detail the role of aggregation methods in analyzing network performance. Maria Carla Calzarossa presents a tool for mail servers benchmarking.

The next group of papers is dedicated towards reliability and dependability analysis. William Sanders gives an overview of selected performance/dependability modeling tools motivating the need for multi-formalism and multi-solution-method tools, provides an overview of the Möbius multiformalism, multi-solution modeling tool, and describes new enhancements to the tool by us and others. Isi Mitrani investigates a class of models where one or more queues are served by a number of unreliable but repairable processors. He describes methods for computing the steady-state performance of such systems. Kishor Trivedi provide in his paper an up-to-date treatment of advanced analytic, state-spacebased, modeling techniques to study the dependability models with non-exponential distributions. Ravi Iyer completes this section with a paper on measurement-based analysis of networked system availability.

Ed Coffmann has contributed to the field of PE in optical networks, he presents a paper on asymptotically optimal wavelength reservation for optical burst switching. Satish Tripathi identifies in his paper channel contention, routing and support for quality of service as the key challenges in PE of wireless networks. He presents recent work addressing these challenges in multi-hop networks.

The next two papers address specific application areas for performance evaluation. Heinz Beilner motivates and presents in his paper an object-based, hierarchical approach for model-based assessment and evaluation of logistics networks. Gerard Reijns studies the performance of parallel programs and presents a method to predict their execution time under stochastic workload.

The last two papers discuss the influence of system characteristics on PE. Rick Bunt tracks the locality phenomenon and its application, across time and across applications. The underlying notion behind locality is that references to artifacts or resources (e.g. memory pages, files, network addresses, web documents, etc.) distribute non-randomly, clustering in both time (temporal locality) and space (spatial locality). S.V. Raghavan concludes the symposium with a presentation on workload characterization.

All of us working in performance evaluation will most likely share the perspective of performance evaluation still being an amazing and exciting field. Advances in architectures, new computing paradigms, trends such as multimedia integration and ubiquitous networking do not only pose challenges on system developers but also on the performance analysts. Models which have been proven successful for “traditional” computer systems and communication networks need to be revisited in order to meet the characteristics of modern computing environments. Dynamics and flexibility in the systems also requires appropriate evaluation techniques. I am looking forward to many new contributions in the future which we can report in 2013 at the occasion of Günter’s 70th birthday!

Gabriele Kotsis

Linz / Vienna, December 2003

CONTENTS

Insularity Revisited <i>Domenico Ferrari</i>	1
Milestones in the Evolution of Best/1® <i>Jeffrey P. Buzen</i>	11
Analytical, Simulation and Measurement Techniques: Experiences with an Integrated Modeling Environment <i>Edmundo De Souza E Silva, Rosa M.M. Leao, Richard M. Muntz</i>	27
Automated Diagnosis of Distributed Simulation Performance <i>Alois Ferscha</i>	47
Fast Simulation <i>Qingwei Li, Hisashi Kobayashi</i>	73
Estimating Bottlenecks of Very Large Models <i>Giuliano Casale, Giuseppe Serazzi</i>	89
Open Queueing Networks with Blocking - A Personal Log <i>Harry G. Perros</i>	105
Compositional Reversed Markov Processes <i>Peter G. Harrison</i>	117
Perspectives On the Numerical Solution of Markov Chains <i>William J. Stewart</i>	137
Robust Computation Through Stable Recurrent Expressions <i>Raymond Marie</i>	153
From Norton to Performance Enhanced Specifications <i>Ulrich Herzog</i>	165
Approaches for Evaluating the Performance of Mascot Designs <i>Carlos Juiz and Ramon Puigjaner</i>	179
Software Performance Engineering <i>Connie U. Smith</i>	193
The Role of Awareness in Internet Protocol Performance <i>Carey Williamson</i>	203
Aggregation Methods for Performance Evaluation of Communication Networks <i>Monique Becker, A.-L. Beylot and Rhiad Dhaou</i>	215

A Tool for Mail Servers Benchmarking <i>Maria Carla Calzarossa</i>	231
Multi-Formalism and Multi-Solution-Method Modeling Frameworks: the Möbius Approach <i>William H. Sanders, Tod Courtney, Daniel Deavours, David Daly, Salem Derisavi, Vinh Lam</i>	241
Performance in the Presence of Unreliability <i>Isi Mitrani</i>	257
Dealing with Non-Exponential Distributions in Dependability Models <i>Dazhi Wang, Ricardo M. Fricks, Kishor S. Trivedi</i>	273
Measurement-Based Analysis of Networked System Availability <i>Ravishankar K. Iyer</i>	303
Asymptotically Optimal Wavelength Reservation for Optical Burst Switching <i>Lachlan L. H. Andrew, Yuliy Baryshnikov, E. G. Coffman, Jr., Stephen V. Hanly, Jolyon White</i>	323
Challenges in the Evolution From Single-Hop to Multi-Hop wireless Networks <i>Satish K. Tripathi, Prasun Sinha</i>	333
Model-Based Evaluation of Logistics Networks <i>Heinz Beilner</i>	353
On the Use of Pierson Distributions for the Performance Prediction of Parallel Programs <i>G.L. Reijns, A.J.C. Van Gemund, H. Gautama</i>	365
Temporal and Spatial Locality: A Time and a Place for Everything <i>Rick Bunt and Carey Williamson</i>	381
User Behavior Index Based Workload Characterization and Modeling <i>S.V. Raghavan</i>	393