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In Memory of
Nadia Busi

Preface

This volume presents the set of papers accompanying the lectures of the eighth International School on Formal Methods for the Design of Computer, Communication, and Software Systems (SFM).

This series of schools addresses the use of formal methods in computer science as a prominent approach to the rigorous design of computer, communication, and software systems. The main aim of the SFM series is to offer a good spectrum of current research in foundations as well as applications of formal methods, which can be of help for graduate students and young researchers who intend to approach the field.

SFM 2008 was devoted to formal techniques for computational systems biology and covered several aspects of the field, including computational models, calculi and logics for biological systems, and verification and simulation methods. The school featured not only regular lectures, but also talks given by people involved in the Italian research project on Bio-Inspired Systems and Calculi with Applications (BISCA).

The first part of this volume comprises nine papers based on regular lectures. The paper by Degasperi and Gilmore describes the application of sensitivity analysis techniques to stochastic simulation algorithms. Talcott's paper presents pathway logic, an approach to modeling and analysis of biological processes based on rewriting logic. Fages and Soliman study reaction graphs and activation/inhibition graphs used by biologists through formal methods originating from programming theory. The paper by Maus, John, Röhl, and Uhrmacher discusses categories, abstraction hierarchies, and composition hierarchies playing a role in modeling and simulation for computational biology. Gillespie's paper reviews the theory of stochastic chemical kinetics and several simulation methods that are based on that theory. Păun and Romero-Campero introduce membrane computing, a branch of natural computing aiming to abstract computing models from the structure and functioning of the living cell and the way cells cooperate. The paper by Heiner, Gilbert, and Donaldson illustrates a Petri-net-based framework for modeling and analyzing biochemical pathways, which unifies the qualitative, stochastic, and continuous paradigms. Ciocchetta and Hillston discuss the use of process algebras within systems biology and the related analysis techniques by focussing on Bio-PEPA. Finally, the paper by Dematté, Priami, and Romanel presents BlenX, a new programming language whose original development was thought for biological systems.

The second part of this volume comprises five papers based on BISCA talks. Chiarugi, Degano, Van Klinken, and Marangoni report on experiences in modeling biological cells with process calculi by following a holistic approach. The paper by Barbuti, Caravagna, Maggiolo–Schettini, Milazzo, and Pardini describes the calculus of looping sequences, which is suitable for modeling microbiological

systems and their evolution. Bortolussi and Policriti survey the use of hybrid automata in systems biology through a series of case studies. The paper by Versari and Gorrieri shows how different compartment semantics useful in biological systems modeling can be obtained by means of a simple and conservative extension of π-calculus. Finally, Zavattaro's paper uniformly introduces various models for the representation of biochemical systems recently proposed in the literature.

We believe that this book offers a comprehensive view of what has been done and what is going on worldwide in the field of formal methods for computational systems biology. We wish to thank all the speakers and all the participants for a lively and fruitful school. We also wish to thank the entire staff of the University Residential Center of Bertinoro for the organizational and administrative support. Finally, we are very grateful to the University of Bologna, which kindly provided a sponsorship for this event under the International Summer School Program.

We would like to conclude by remembering our friend and colleague Nadia Busi. Her most important research contributions were related to the study of expressiveness problems in concurrency theory, with special emphasis on Petri nets as well as calculi inspired by coordination languages. In 1998 her doctoral dissertation "Petri Nets with Inhibitor and Read Arcs: Semantics, Analysis and Application to Process Calculi" received the EATCS-IT prize for the best Italian PhD thesis in theoretical computer science. More recently, she became interested in bio-inspired models of computation. In that field, she developed new classes of models, such as genetic P systems, and investigated decidability properties of other formalisms, like brane calculi. She also led the research unit of the University of Bologna within the BISCA project.

Unfortunately Nadia passed away a few months ago at the age of 39, after playing – with her usual enthusiasm – a fundamental role in planning the scientific program of SFM 2008. Despite the sadness due to her unexpected death, we decided to proceed with the organization of the school, because SFM 2008 can be viewed as her last contribution to the scientific community – or maybe because organizing SFM 2008 gave us a chance to feel Nadia still close to us. This volume is therefore dedicated to the memory of Nadia Busi.

June 2008

Marco Bernardo
Pierpaolo Degano
Gianluigi Zavattaro

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