

Preface

This volume collects a set of papers accompanying the lectures of the 16th 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 the above-mentioned 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 to graduate students and young researchers who intend to approach the field. SFM 2016 was devoted to the quantitative evaluation of collective adaptive systems and covered topics such as self-organization in distributed systems, scalable quantitative analysis, spatio-temporal models, and aggregate programming. The eight papers of this volume represent the broad range of topics of the school.

The paper by Talcott, Nigam, Arbab, and Kappé proposes a framework called Soft Agents, formalized in the Maude rewriting logic system, to describe systems of cyber-physical agents that operate in unpredictable, possibly hostile, environments using locally obtainable information. Ghezzi's paper is a tutorial on how to design adaptable and evolvable systems that support safe continuous software deployment to guarantee correct operation in the presence of dynamic reconfigurations. Bortolussi and Gast study the limiting behavior of stochastic models of populations of interacting agents, as the number of agents goes to infinity, in the case that classical conditions ensuring the validity of mean-field results based on ordinary differential equations do not hold. The paper by Loreti and Hillston illustrates CARMA, a language recently defined to support specification and analysis of collective adaptive systems, and its tools developed for system design and analysis. Galpin's paper provides an overview of models of individuals and models of populations for collective adaptive systems, in which discrete or continuous space is explicitly represented. Ciancia, Latella, Loreti, and Massink also address spatial aspects of collective adaptive systems through a topology-inspired approach to formal verification of spatial properties, which is based on the logics SLCS and STLCS and their model-checking algorithms. The paper by Vandin and Tribastone shows how to efficiently analyze quantitative properties of large-scale collective adaptive systems by reviewing algorithms that reduce the dimensionality of models in a way that preserves modeler-defined state variables. Finally, Beal and Viroli present aggregate programming, a new paradigm for coping with an ever-increasing density of computing devices that raises the level of abstraction in order to allow programmers to reason in terms of collections of interacting devices.

We believe that this book offers a useful view of what has been done and what is going on worldwide in the field of formal methods for the quantitative evaluation of collective adaptive systems. This school was organized in collaboration with the EU FP7 project QUANTICOL, whose support we gratefully acknowledge. We wish to thank all the speakers and all the participants for a lively and fruitful school. We also

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