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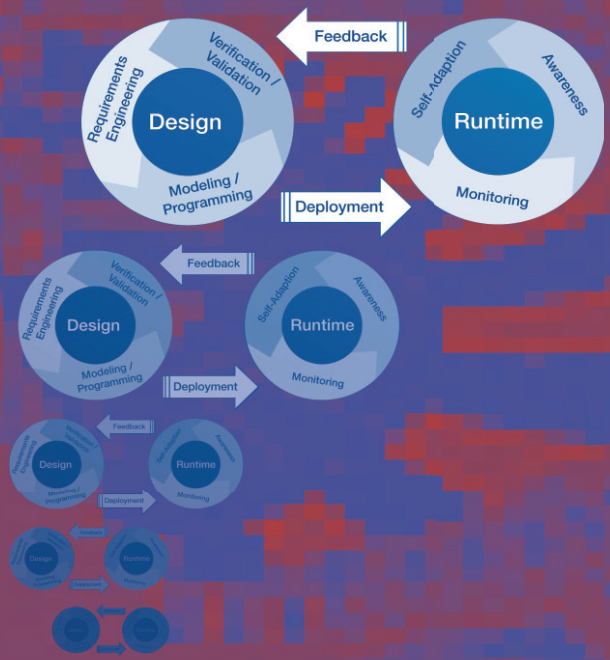
Nora Koch Philip Mayer (Eds.)

Software Engineering for Collective Autonomic Systems

The ASCENS Approach



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Volume Editors

Martin Wirsing
Matthias Hölzl
Nora Koch
Philip Mayer
Ludwig-Maximilians-Universität
Institut für Informatik
Oettingenstraße 67, 80538 München, Germany
E-mail: {wirsing, hoelzl, kochn, mayer}@pst.ifi.lmu.de

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Preface

A collective autonomic system consists of collaborating autonomic entities that are able to adapt at runtime, adjusting to the state of the environment and incorporating new knowledge into their behavior. These highly dynamic systems are also known as ensembles. To ensure the correct behavior of ensembles it is necessary to support their development through appropriate methods and tools that can guarantee an autonomic system lives up to its intended purpose; this includes respecting important constraints of the environment.

This book addresses the engineering of such systems by presenting the methods, tools, and theories developed within the ASCENS project. ASCENS[1] was an integrated project funded in the period 2010–2015 by the 7th Framework Programme (FP7) of the European Commission as part of the Future Emerging Technologies Proactive Initiative (FET Proactive). The ASCENS Consortium consisted of 14 partners of seven countries and one third party, from which nine are universities, three research organizations, and three companies (two SMEs). The project was coordinated by the Ludwig-Maximilians-Universität München. ASCENS participated in the coordination actions AWARENESS[2] and FOCAS[3].

The ASCENS approach is both formal and pragmatic. Formal means that it provides a range of foundational theories and methods that support requirements engineering, modeling, programming, formal reasoning, validation and verification, monitoring and dynamic adaptation of autonomic systems. As a guide for performing these tasks, ASCENS has defined a process model for systems development called the Ensemble Development Life Cycle (EDLC). The EDLC takes both the design and runtime of an autonomic system into account, and includes mechanisms for enabling design changes based on the system's and environmental awareness obtained during runtime.

The pragmatic nature of the ASCENS approach manifests itself in three case studies: autonomic robot swarms performing rescue operations, autonomic cloud computing platforms transforming numerous small computers into a supercomputing environment, and autonomic e-mobility support that addresses decision making in transportation systems.

This book is divided into four parts corresponding to the research areas of the project and their concrete applications: (I) language and verification for self-awareness and self-expression, (II) modeling and theory of self-aware and adaptive systems, (III) engineering techniques for collective autonomic systems, and, last but not least, (IV) challenges and feedback provided by the case studies of the project in the areas of swarm robotics, cloud computing, and e-mobility.

[1] http://www.ascens-ist.eu/
[2] http://www.aware-project.eu/
[3] http://focas.eu/

Many people contributed to the success of the ASCENS project. We extend our sincere thanks to all of them. We are particularly grateful to the EC project officers Wide Hogenhout, Dagmar Floeck, and Dalibor Grgec. We thank the reviewers Richard Anthony, Jim Davies, Paola Inverardi, Fernando Orejas, Ralf Reussner, and Carles Sierra for their always constructive criticism and helpful suggestions. We are also grateful to Springer for the assistance in producing this book. Our sincere thanks go to all authors for the high quality of their scientific contributions and to the reviewers of the book chapters for their careful reading and suggestions for improvements. Finally, we thank all ASCENS members for the excellent work, their inexhaustible effort and never-ending enthusiasm for achieving the goals of the project and even going further in their research activities.

February 2015

Martin Wirsing
Matthias Hölzl
Nora Koch
Philip Mayer

Project Partners

Ludwig-Maximilians-Universität München, Germany
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