Lecture Notes in Computer Science

11865

Founding Editors

Gerhard Goos Karlsruhe Institute of Technology, Karlsruhe, Germany Juris Hartmanis Cornell University, Ithaca, NY, USA

Editorial Board Members

Elisa Bertino Purdue University, West Lafayette, IN, USA Wen Gao Peking University, Beijing, China Bernhard Steffen TU Dortmund University, Dortmund, Germany Gerhard Woeginger RWTH Aachen, Aachen, Germany Moti Yung Columbia University, New York, NY, USA More information about this series at http://www.springer.com/series/7407

Maurice H. ter Beek · Alessandro Fantechi · Laura Semini (Eds.)

From Software Engineering to Formal Methods and Tools, and Back

Essays Dedicated to Stefania Gnesi on the Occasion of Her 65th Birthday



Editors Maurice H. ter Beek Consiglio Nazionale delle Ricerche Pisa, Italy

Laura Semini D Università di Pisa Pisa, Italy Alessandro Fantechi D Università degli Studi di Firenze Florence, Italy

ISSN 0302-9743 ISSN 1611-3349 (electronic) Lecture Notes in Computer Science ISBN 978-3-030-30984-8 ISBN 978-3-030-30985-5 (eBook) https://doi.org/10.1007/978-3-030-30985-5

LNCS Sublibrary: SL1 - Theoretical Computer Science and General Issues

© Springer Nature Switzerland AG 2019

This work is subject to copyright. All rights are reserved by the Publisher, whether the whole or part of the material is concerned, specifically the rights of translation, reprinting, reuse of illustrations, recitation, broadcasting, reproduction on microfilms or in any other physical way, and transmission or information storage and retrieval, electronic adaptation, computer software, or by similar or dissimilar methodology now known or hereafter developed.

The use of general descriptive names, registered names, trademarks, service marks, etc. in this publication does not imply, even in the absence of a specific statement, that such names are exempt from the relevant protective laws and regulations and therefore free for general use.

The publisher, the authors and the editors are safe to assume that the advice and information in this book are believed to be true and accurate at the date of publication. Neither the publisher nor the authors or the editors give a warranty, expressed or implied, with respect to the material contained herein or for any errors or omissions that may have been made. The publisher remains neutral with regard to jurisdictional claims in published maps and institutional affiliations.

Cover illustration: The cover illustration is the work of Eleonora Fantechi, Italy. Used with permission. Photograph on p. V: The photograph of the honoree was taken by Nico Plat, The Netherlands. Used with permission.

This Springer imprint is published by the registered company Springer Nature Switzerland AG The registered company address is: Gewerbestrasse 11, 6330 Cham, Switzerland



Stefania Gnesi

Preface

This Festschrift contains 32 contributions by collaborators, colleagues, and friends of Stefania Gnesi to celebrate her 65th birthday.

The Festschrift consists of eight sections, seven of which reflect the main research areas to which Stefania has contributed. Following a survey of Stefania's legacy in research and a homage by her thesis supervisor, these seven sections are ordered according to Stefania's life cycle in research, *from software engineering to formal methods and tools, and back*:

- Software Engineering
- Formal Methods and Tools
- Requirements Engineering
- Natural Language Processing
- Software Product Lines
- Formal Verification
- Applications

Each contribution was carefully reviewed by two readers. We would like to thank these colleagues, listed on the following page, for their assistance.

The Festschrift was presented to Stefania on October 8, 2019, during a one-day colloquium held in Porto, Portugal, preceding the 23rd Symposium on Formal Methods (FM 2019), as part of the 3rd World Congress on Formal Methods. We would like to thank José N. Oliveira, general chair of FM 2019, and his team for the organization of this colloquium, internally known as secret project 'X'.

Finally, we would like to thank Springer, and in particular Alfred Hofmann, for agreeing to publish this Festschrift and we acknowledge the support from EasyChair for assisting us in managing the complete process from submissions to this volume.

21 July 2019

Maurice H. ter Beek Alessandro Fantechi Laura Semini

Organization

Reviewers

Davide Basile Maurice ter Beek Cinzia Bernardeschi Antonia Bertolino Tommaso Bolognesi Antonio Bucchiarone Silvano Chiaradonna Vincenzo Ciancia Rocco De Nicola Pierpaolo Degano Felicita Di Giandomenico Alessandro Fantechi Alessio Ferrari Gian Luigi Ferrari José Fiadeiro John Fitzgerald Mario Fusani Gabriele Lenzini Letterio Galletta Vincenzo Gervasi Carlo Ghezzi Patrick Heymans Paola Inverardi Giuseppe Lami Cosimo Laneve

Diego Latella Axel Legay Antónia Lopes Dino Mandrioli Tiziana Margaria Mieke Massink Radu Mateescu Franco Mazzanti Pedro Merino Luisa Mich Marinella Petrocchi Andrea Polini **Rosario Pugliese** Barbara Re Matteo Rossi Klaus Schmid Laura Semini Giorgio Spagnolo Paola Spoletini Bernhard Steffen Francesco Tiezzi Gianluca Trentanni Andrea Vandin Erik de Vink Martin Wirsing

Contents

The Legacy of Stefania Gnesi: From Software Engineering to Formal	
Methods and Tools, and Back	1
Maurice H. ter Beek, Alessandro Fantechi, and Laura Semini	
From Dynamic Programming to Programming Science: Some	
Recollections in Honour of Stefania Gnesi	12
Ugo Montanari	

Software Engineering

Ten Years of Self-adaptive Systems: From Dynamic Ensembles to Collective Adaptive Systems	19
Multi-modelling and Co-simulation in the Engineering of Cyber-Physical Systems: Towards the Digital Twin John Fitzgerald, Peter Gorm Larsen, and Ken Pierce	40
Changing Software in a Changing World: How to Test in Presence of Variability, Adaptation and Evolution? Antonia Bertolino and Paola Inverardi	56
Improving Software Engineering Research Through Experimentation Workbenches	67
Formal Methods and Tools	
Innovating Medical Image Analysis via Spatial Logics Gina Belmonte, Vincenzo Ciancia, Diego Latella, and Mieke Massink	85
Formal Methods in Designing Critical Cyber-Physical Systems Mehrnoosh Askarpour, Carlo Ghezzi, Dino Mandrioli, Matteo Rossi, and Christos Tsigkanos	110
Automata-Based Behavioural Contracts with Action Correlation Davide Basile, Rosario Pugliese, Francesco Tiezzi, Pierpaolo Degano, and Gian-Luigi Ferrari	131
Logical Support for Bike-Sharing System Design Ionuț Țuțu, Claudia Elena Chiriță, Antónia Lopes, and José Luiz Fiadeiro	152

A Generic Dynamic Logic with Applications to Interaction-Based Systems. . . . 172 Rolf Hennicker and Martin Wirsing

Requirements Engineering

Ambiguity in Requirements Engineering: Towards a Unifying Framework Vincenzo Gervasi, Alessio Ferrari, Didar Zowghi, and Paola Spoletini	191
QuARS: A Pioneer Tool for NL Requirement Analysis Giuseppe Lami, Mario Fusani, and Gianluca Trentanni	211
Detecting Feature Interactions in FORML Models Sandy Beidu and Joanne M. Atlee	220

Natural Language Processing

David Benavides

Comparing Results of Natural Language Disambiguation Tools with Reports of Manual Reviews of Safety-Related Standards	239
Looking Inside the Black Box: Core Semantics Towards Accountability of Artificial Intelligence <i>Roberto Garigliano and Luisa Mich</i>	250
QuOD: An NLP Tool to Improve the Quality of Business Process Descriptions	267
Software Product Lines	
A Decade of Featured Transition Systems	285
Product Line Verification via Modal Meta Model Checking Tim Tegeler, Alnis Murtovi, Markus Frohme, and Bernhard Steffen	313
Towards Model Checking Product Lines in the Digital Humanities: An Application to Historical Data <i>Ciara Breathnach, Najhan M. Ibrahim, Stuart Clancy,</i> <i>and Tiziana Margaria</i>	338
Variability Modelling and Analysis During 30 Years	365

Formal Verification

A Systematic Approach to Programming and Verifying Attribute-Based Communication Systems	377
On the Prediction of Smart Contracts' Behaviours Cosimo Laneve, Claudio Sacerdoti Coen, and Adele Veschetti	397
Hunting Superfluous Locks with Model Checking Viet-Anh Nguyen, Wendelin Serwe, Radu Mateescu, and Eric Jenn	416
Formal Verification of Railway Timetables - Using the UPPAAL Model Checker	433
An Axiomatization of Strong Distribution Bisimulation for a Language with a Parallel Operator and Probabilistic Choice Jan Friso Groote and Erik P. de Vink	449
Applications	
Enabling Auditing of Smart Contracts Through Process Mining Flavio Corradini, Fausto Marcantoni, Andrea Morichetta, Andrea Polini, Barbara Re, and Massimiliano Sampaolo	467
A Refined Framework for Model-Based Assessment of Energy Consumption in the Railway Sector	481
Modelling of Railway Signalling System Requirements by Controlled Natural Languages: A Case Study Gabriele Lenzini and Marinella Petrocchi	502
Single-Step and Asymptotic Mutual Information in Bipartite Boolean Nets Tommaso Bolognesi	519
Application of Model Checking to Fault Tolerance Analysis Cinzia Bernardeschi and Andrea Domenici	531
How Formal Methods Can Contribute to 5G Networks María-del-Mar Gallardo, Francisco Luque-Schempp, Pedro Merino-Gómez, and Laura Panizo	548
Author Index	573