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Software Engineering and Formal Methods

SEFM 2015 Collocated Workshops:
ATSE, HOFM, MoKMaSD, and VERY*SCART
York, UK, September 7–8, 2015, Revised Selected Papers

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Preface

This volume contains the technical papers presented in the four workshops collocated with SEFM 2015, the 13th International Conference on Software Engineering and Formal Methods 2015. The workshops were held in York, UK, during September 7–8, 2015.

SEFM 2015 brought together researchers and practitioners from academia, industry, and government to advance the state of the art in formal methods, to facilitate their uptake in the software industry, and to encourage their integration within practical software engineering methods and tools. The satellite workshops provided a highly interactive and collaborative environment for researchers and practitioners from industry and academia to discuss emerging areas of software engineering and formal methods.

The four workshops were:

- ATSE 2015 — The 6th Workshop on Automating Test Case Design, Selection and Evaluation
- HOFM 2015 — The Second Human-Oriented Formal Methods Workshop
- MoKMaSD 2015 — The 4th International Symposium on Modeling and Knowledge Management Applications: Systems and Domains
- VERY*SCART 2015 — The First International Workshop on the Art of Service Composition and Formal Verification for Self-* Systems.

A brief description of each workshop, written by its organizers, and the abstracts of the keynote talks follow.

We are grateful to EasyChair for the support with the paper submission and reviewing process for all workshops, and with the preparation of this volume. For each of the workshops at SEFM 2015, we thank the organizers for the interesting topics and resulting talks. We also thank the paper contributors to these workshops and those who attended them. We would like to extend our thanks to all keynote speakers for their support and excellent presentations, and also, to the members of each workshop's Program Committee.

November 2015

Domenico Bianculli
Radu Calinescu
Bernhard Rumpe

ATSE 2015 Organizers' Message

The 6th Workshop on Automating Test Case Design, Selection and Evaluation (ATSE 2015), was held this year in conjunction with the 13th International Conference on Software Engineering and Formal Methods (SEFM), in York, UK, on September 7, 2015. Again we had a very interesting workshop that provided a venue for researchers as well as industry participants to exchange and discuss trending views, ideas, state-of-the-art work and work in progress, and scientific results on automated test case design, selection, and evaluation. In all, 40 % of the workshop participants came from industry.

We started off with a keynote by Joachim Wegener from Berner & Mattner (Germany) on "Automatic Generation and Execution of Test Scenarios for Camera-Based Driver Assistance Systems." This was followed by the keynote of Cristina Seceleanu from MDH (Sweden) on "Testing Function and Time for Embedded Systems." Subsequently, and based on the submissions received this year for ATSE 2015, the workshop concentrated on three topics:

1. Learning-based testing
2. User experience design and testing
3. Model-based statistical testing

The workshop format was highly interactive. We urged the participants to come to the workshop prepared by having already read the papers. This way we could focus the discussions on the topics and start to set an agenda and lay the foundation for future development.

We enjoyed ATSE 2015 greatly and look forward to the next edition! The program chairs would like to thank all of the reviewers for their excellent work and are grateful to everybody involved in the ATSE 2015 workshop for their support before, during, and after the workshop.

November 2015

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HOFM 2015 Organizers' Message

The aim of the Human-Oriented Formal Methods (HOFM) workshop series is to bring together researchers and practitioners from academia and industry to exchange ideas and experience in the field of the application of human factors to the analysis and to the optimization of formal methods, as well as to present ongoing research and emerging results in this field. HOFM also aims to develop a future vision and roadmap of usability and automation of formal methods, focusing especially on readability and ease of use.

The Second Human-Oriented Formal Methods (HOFM) Workshop was held on September 7, 2015, in York, UK. This international workshop was affiliated to the 13th International Conference on Software Engineering and Formal Methods (SEFM 2015). The aim of the HOFM workshop series is to establish a community that will investigate the field of application of human factors to the analysis and to the optimization of formal methods. Formal methods (FMs) have been successfully applied in software engineering research for several decades. However, many software engineers largely reject FMs as "too hard to understand and use in practice" while admitting that they are powerful and precise. The reason for this rejection is the lack of usability features: If usability is compromised, methods cannot fit in a real software development process.

There are many applications of FMs to analyze human–machine interaction and to construct user interfaces. However, the field of application of human factors to the analysis and to the optimization of FMs in the sense of usability is almost unexplored. The first and second editions of the workshop showed that there is interest in collaborations and discussions on this topic, and that there are currently more questions than answers in this field. Bad design of interfaces and languages can induce unnecessary human error, cf., e.g., [7]; however, the error information can be used to improve the quality of software and the corresponding development artifacts, also including FMs [1, 2, 5, 8]. "Formal" does not mean "unreadable," and the readability and usability of FMs might be increased by analyzing human factors related to the specification, modeling, and verification [4].

HOFM 2015 received submissions from 15 authors, affiliated with universities and industry from the UK, Germany, Israel, Norway, Australia, The Netherlands, and Tunisia. Each submission was reviewed by at least three Program Committee members, and five regular papers were accepted for presentation at HOFM 2015.

The HOFM 2015 pre-workshop proceedings, which include all papers presented at the workshop, are available online at the workshop site [3]. All HOFM authors were invited to submit extended versions of their peer-reviewed papers to the post-workshop proceedings, taking into account the feedback from the HOFM reviewers as well as the discussions during the workshop.

An introduction to the second HOFM workshop was given by the keynote talk "Beating Error with Formal Methods," given by Harold Thimbleby, Swansea University, Wales, UK. In this presentation, Thimbleby emphasized that FMs provide another point of view, namely, mathematical reasoning, on software engineering problems, and this special point of view can help to identify issues that normal human

thinking misses. This introduction led the workshop discussion on the point that FMs are very important for software engineering, especially for the field of safety-critical systems, but their limited understandability might become an obstacle for the broad application of FMs.

The workshop was concluded by an open discussion on the topics of the regular paper talks and the keynote talk as well as on the roadmap for research on human factors in formal methods.

The goal of the open discussion was to stimulate collaboration between researchers and to develop a future vision and roadmap of usability, automation, and other human-oriented aspects of FMs, focusing especially on readability and understandability.

The main focus of the discussion was on the teaching of FMs and the human factors that are related to this learning and teaching activity. Workshop presenters and participants agreed that in order to make progress toward adoption of FMs in industry, we have to work on the popularization of FMs as a part of the university curriculum, also taking into account the different backgrounds and aims of the students.
The discussion further focused on the following questions:

- How can we influence the readability, understandability, and perception of FMs?
- How can we deal with collaborative aspects of specification and verification?
- How can we contribute to the sustainability of the FMs (and through FMs)?

One of the early results of this discussion is paper [6], accepted for presentation at the International Workshop on Automated Testing of Cyber-Physical Systems in the Cloud.

We would like to thank all authors who contributed to HOFM 2015 as well as all workshop participants. We hope that the participants found the program inspiring and relevant to their interests. We also thank the SEFM workshop chairs and local organizers for their help. We would like to express our gratitude to the Program Committee members for their support and thorough reviews.

November 2015

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MoKMaSD 2015 Organizers' Message

The 4th International Symposium on Modelling and Knowledge Management Applications: Systems and Domains (MoKMaSD 2015) was held in York, UK, on September 8, 2015. The aim of the symposium is to bring together practitioners and researchers from academia, industry, government, and non-government organizations to present research results and exchange experiences, ideas, and solutions for modelling and analyzing complex systems and for using knowledge management strategies, technology, and systems in various domain areas such as ecology, biology, medicine, climate, governance, education, and social software engineering. In particular, the focus is on synergistic approaches that integrate modelling and knowledge management/discovery or exploit knowledge management/discovery to develop/synthesize system models.

After a careful review process, the Program Committee accepted nine papers and two oral presentations with extended abstracts for the proceedings. The program of MoKMaSD 2015 was enriched by the keynote speeches by Tias Guns entitled "Constraint Modelling and Solving for Data Mining" and by Guido Sanguinetti entitled "Machine Learning Methods for Model Checking in Continuous Time Markov Chains."

Several people contributed to the success of MoKMaSD 2015. We are grateful to Antonio Cerone, who invited us to chair this edition of the symposium and assisted us in some organizational aspects of the event. We would like to thank the organizers of SEFM 2015, and in particular the general chair, Jim Woodcock, and the workshops chair, Domenico Bianculli. We would also like to thank the Program Committee and the additional reviewers for their work in reviewing the papers. The process of reviewing and selecting papers was significantly simplified through using EasyChair.

We thank all the symposium attendants and hope that this event will enable a good exchange of ideas and generate new collaborations among attendees.

The organization of MoKMaSD 2015 was supported by the research project "Metodologie computazionali per la medicina personalizzata" funded by the University of Pisa (Project reference: PRA_2015_0058).

November 2015

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VERY*SCART 2015 Organizers' Message

The First Workshop on The Art of Service Composition and Formal Verification for Self-* Systems (VERY*SCART) was held in York, UK, on September 8, 2015, and was affiliated with SEFM 2015. The event originated from the fusion of the second edition of VERY* and the first edition of SCART and was devised for bringing together researchers and practitioners from various areas related to service composition and verification.

In the near future we will be increasingly surrounded by a virtually infinite number of software/hardware services that can be composed to build new applications and systems. To cope with the changing requirements and emergent behaviors, system designers and software engineers need ad-hoc paradigms and technologies to define suitable reconfigurability mechanisms that allow systems to work correctly with respect to the new settlement. The production of application programming interfaces (APIs) is growing exponentially and some companies are accounting for billions of dollars in revenue per year via API links to their services. Moreover, the "Future Internet" (FI) is expected to lead to an ultra-large number of available services, hence increasing their number to billions of services in the near future. Finally, "cyber-physical systems" (CPS) will lead to the pervasive presence of computing and communication devices in everyday life. This situation radically changes the way systems will be produced and used: (a) systems are increasingly produced according to a certain goal and by integrating existing components; (b) the focus of system development is on integration of third-parties components that are only provided with an interface that exposes the available functionalities and, sometimes, the interaction protocol; (c) after deployment they must be able to cope with dynamically changing requirements and emergent behaviors caused by uncertainty in the surrounding environment. This calls for new integration paradigms and patterns, formal composition theories, integration architectures, as well as flexible and dynamic composition and verification mechanisms. Despite the great interest in software composition and self-* systems, no common formal methods (FM) and software engineering (SE) approaches have been established yet. Developing FI applications and self-adaptive, self-reconfiguring, and self-organizing CPS encompasses a variety of formally grounded and practical aspects, ranging from modelling and analysis issues, to integration code synthesis, implementation and run-time management issues, model checking, and formal verification.

VERY*SCART 2015 aimed at providing innovative contributions in the research and development of novel FM and SE approaches to the design, development, validation, and execution of FI applications and self*-systems composed of available components. In particular, the workshop provided the opportunity to discuss how FI and CPS affect the traditional methods and tools, and how facing complexity in terms of scalability, heterogeneity, and dynamicity promotes the integration of FM within SE practices. The goal was to seek answers on how the rigorousness of FM assists engineers while designing, developing, validating, and operating systems that are built via correct-by-construction composition. The interplay between SE and FM is by

nature tightly intertwined with the "art" of service composition and formal verification. In order to make this art effective and elevate its maturity to the "readiness level" required for its adoption in practical contexts, novel formally grounded approaches, methods, and tools are required, especially when automation and correctness of the desired composition is of paramount importance.

The workshop was partially supported by the Italian Chapter of the EATCS, the INdAM – GNCS Programme 2015, the Italian PRIN Programme 2010–2011, and the H2020 EU project CHOReVOLUTION. The VERY*SCART workshop received contributions covering topics related to: run-time adaptive service composition, run-time adaptation, composite cloud and internet applications, distributed coordination and adaptation, automatic choreography synthesis and enforcement, fuzzy description logics for service composition, architectural design for the FI, runtime verification of self-adaptive systems, automatic decision support, automated protocol synthesis, and spatio-temporal reasoning. Each paper was formally peer reviewed by at least three Program Committee members.

Many people contributed to the success of the VERY*SCART 2015 workshop at SEFM 2015. We would like to acknowledge the SEFM workshop chair for his impeccable support and all Program Committee members for the timely delivery of reviews and constructive discussions given the very tight review schedule. Finally, we would like to thank the authors—without them the event simply would not exist.

November 2015

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