Lecture Notes in Computer Science 10223

Commenced Publication in 1973
Founding and Former Series Editors:
Gerhard Goos, Juris Hartmanis, and Jan van Leeuwen

Editorial Board

David Hutchison
Lancaster University, Lancaster, UK
Takeo Kanade
Carnegie Mellon University, Pittsburgh, PA, USA
Josef Kittler
University of Surrey, Guildford, UK
Jon M. Kleinberg
Cornell University, Ithaca, NY, USA
Friedemann Mattern
ETH Zurich, Zurich, Switzerland
John C. Mitchell
Stanford University, Stanford, CA, USA
Moni Naor
Weizmann Institute of Science, Rehovot, Israel
C. Pandu Rangan
Indian Institute of Technology, Madras, India
Bernhard Steffen
TU Dortmund University, Dortmund, Germany
Demetri Terzopoulos
University of California, Los Angeles, CA, USA
Doug Tygar
University of California, Berkeley, CA, USA
Gerhard Weikum
Max Planck Institute for Informatics, Saarbrücken, Germany

More information about this series at http://www.springer.com/series/7408

Jácome Cunha · João P. Fernandes
Ralf Lämmel · João Saraiva
Vadim Zaytsev (Eds.)

Grand Timely Topics in Software Engineering

International Summer School GTTSE 2015
Braga, Portugal, August 23–29, 2015
Tutorial Lectures

Springer

Editors
Jácome Cunha
Universidade Nova de Lisboa
Caparica
Portugal

João P. Fernandes
Universidade de Coimbra
Coimbra
Portugal

Ralf Lämmel
Universität Koblenz-Landau
Koblenz
Germany

João Saraiva
Universidade do Minho
Braga
Portugal

Vadim Zaytsev
Universiteit van Amsterdam
Amsterdam
The Netherlands

ISSN 0302-9743 ISSN 1611-3349 (electronic)
Lecture Notes in Computer Science
ISBN 978-3-319-60073-4 ISBN 978-3-319-60074-1 (eBook)
DOI 10.1007/978-3-319-60074-1

Library of Congress Control Number: 2017943037

LNCS Sublibrary: SL2 – Programming and Software Engineering

© Springer International Publishing AG 2017
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, express 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.

Printed on acid-free paper

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

Preface

The fifth instance of the International Summer School GTTSE, GTTSE 2015, was held in Braga, Portugal, August 23–29, 2015. For the first up to the fourth instance of GTTSE, the acronym was expanded to "Generative and Transformational Techniques in Software Engineering." For the fifth instance, we adopted a broader scope also hinting at an adjusted vision; GTTSE now stands for "Grand Timely Topics in Software Engineering." That is, historically, in the first four editions of GTTSE, the school series focused on generative and transformational techniques in software engineering. With the rise of the Software Language Engineering conference, the school series also covered that field. As of the fifth edition, a broader scope is applied to include additional areas of software engineering, e.g., software analysis, empirical research, modularity, and product lines, as reflected by the new expansion of the GTTSE acronym. The notion of *timely topics* is inspired by the ICSE conference, which, in some editions, features technical briefings as "a venue for communicating the current state of a timely topic related to software engineering."

The biannual, week-long GTTSE summer school brings together PhD students, lecturers, as well as researchers and practitioners who are interested in timely topics in software engineering. Given the community behind GTTSE, the program does not cover software engineering in a perfectly balanced manner. Instead, there continues to be a focus on language engineering, programming languages, modeling, and software transformation.

The previous four instances of the school were held in 2005, 2007, 2009, and 2011 and their proceedings appeared as volumes 4143, 5235, 6491, and 7680 in Springer's LNCS series. There was no summer school edition in 2013.

The GTTSE 2015 program offered ten tutorials ("briefings"), three hours of plenary time each, and a special tutorial on how to prepare for an interview in industry, one hour of plenary time. All of these tutorials were given by renowned researchers in the extended GTTSE community.

We adopted the notion of "briefing" in an effort to combine survey, research vision, and tutorial regarding an important subject. GTTSE 2015 covered probabilistic program analysis, ontologies in software engineering, empirical evaluation of programming and programming languages, model synchronization, management of software product families, "people analytics" in software development, DSLs in robotics, structured program-generation techniques, advanced aspects of software refactoring, and name binding in language implementation.

The program of the school also included a participants workshop (or students workshop) to which all students had been invited to submit an extended abstract beforehand. The Organizing Committee reviewed these extended abstracts, and invited 14 students to present their work at the workshop. The quality of this workshop was exceptional, and two awards were granted by a jury of senior researchers that was

formed at the school. Three of the participants responded to the call for contributions to the proceedings; two of the submissions were accepted through peer review.

The program of the school and additional resources remain available online.[1]

In this volume, you can find revised and extended lecture notes for eight tutorials or "briefings," in the terminology of GTTSE 2015. Each of these lecture notes was reviewed by three members of the Scientific Committee of GTTSE 2015. You will also find two peer-reviewed participant contributions. Where necessary, two rounds of reviewing were executed.

We are grateful to our sponsors for their support, and to all lecturers and participants of the school for their enthusiasm and hard work in preparing excellent material for the school itself and for these proceedings. Thanks to their efforts the event was a great success, which we trust the reader finds reflected in this volume. Our gratitude is also due to all members of the Scientific Committee, who not only helped with the labor-intensive review process that substantially improved all contributions, but also sent their most suitable PhD students to the school.

March 2017

Jácome Cunha
João P. Fernandes
Ralf Lämmel
João Saraiva
Vadim Zaytsev

[1] http://gttse.wikidot.com/2015.

Organization

GTTSE 2015 was hosted by the Departamento de Informática, Universidade do Minho, Portugal.

General Chair

João Saraiva — Universidade do Minho, Portugal

Briefings Chair

Ralf Lämmel — Universität Koblenz-Landau, Germany

Program Chair

João P. Fernandes — Universidade de Coimbra, Portugal

Industry Chair

Joost Visser — Software Improvement Group, The Netherlands

Participants Workshop Chair

Felienne Hermans — Delft University of Technology, The Netherlands

Organization Chair

Jácome Cunha — Universidade Nova de Lisboa, Portugal

Publicity Chair

Vadim Zaytsev — Universiteit van Amsterdam, The Netherlands

Scientific Committee

Bram Adams	École Polytechnique de Montréal, Canada
Benoit Baudry	Inria, France
Xavier Blanc	Bordeaux 1 University, France
Darius Blasband	Raincode, Belgium
Paulo Borba	Federal University of Pernambuco, Brazil
Mark van den Brand	Eindhoven University of Technology, The Netherlands
Martin Bravenboer	LogicBlox Inc., USA
Jordi Cabot	Inria-École des Mines de Nantes, France

João Cardoso	FEUP/Universidade do Porto, Portugal
Michel Chaudron	Chalmers and Gothenborg University, Sweden
Anthony Cleve	University of Namur, Belgium
Benoît Combemale	Université de Rennes 1, France
Alcino Cunha	Universidade de Minho, Portugal
Jácome Cunha	Universidade Nova de Lisboa, Portugal
Juan De Lara	Universidad Autonoma de Madrid, Spain
Andrea De Lucia	University of Salerno, Italy
Coen De Roover	Vrije Universiteit Brussel, Belgium
Davide Di Ruscio	Università degli Studi dell'Aquila
Zinovy Diskin	McMaster University/University of Waterloo, Canada
Rudolf Ferenc	University of Szeged, Hungary
João M. Fernandes	Universidade do Minho, Portugal
João P. Fernandes	Universidade de Coimbra, Portugal
João Saraiva	Universidade do Minho, Portugal
Mike Godfrey	University of Waterloo, Canada
Martin Gogolla	University of Bremen, Germany
Jeff Gray	University of Alabama, USA
Mark Grechanik	University of Illinois at Chicago, USA
Yann-Gaël Guéhéneuc	École Polytechnique de Montréal, Canada
Gorel Hedin	Lund University, Sweden
Florian Heidenreich	DevBoost GmbH, Germany
Pedro Rangel Henriques	Universidade do Minho, Portugal
Felienne Hermans	Delft University of Technology, The Netherlands
Dirk Heuzeroth	Hochschule Heilbronn, Germany
Robert Hirschfeld	Hasso-Plattner-Institut, Germany
Zhenjiang Hu	NII, Japan
Marianne Huchard	Université Montpellier 2 and CNRS, France
Jean-Marc Jézáquel	University of Rennes 1, France
Foutse Khomh	École Polytechnique de Montréal, France
Holger Kienle	Independent
Dimitris Kolovos	University of York, UK
Nicholas A. Kraft	ABB Corporate Research, USA
Jens Krinke	University College London, UK
Christian Kästner	Carnegie Mellon University, USA
Paul Klint	Centrum Wiskunde & Informatica, The Netherlands
Ralf Lämmel	Universität Koblenz-Landau, Germany
Michele Lanza	University of Lugano, Switzerland
Timothy Lethbridge	University of Ottawa, Canada
David Lo	Singapore Management University, Singapore
Tiziana Margaria	Lero, Ireland
Erik Meijer	Delft University of Technology, The Netherlands
Marjan Mernik	University of Maribor, Slovenia
Ana Moreira	Universidade Nova de Lisboa, Portugal
José Nuno Oliveira	Universidade do Minho, Portugal
Rocco Oliveto	University of Molise, Italy

Richard Paige	University of York, UK
Alfonso Pierantonio	Università degli Studi dell'Aquila, Italy
Juergen Rilling	Concordia University, Canada
Sibylle Schupp	Hamburg University of Technology, Germany
Bran Selic	Malina Software Corp., Canada
Alexander Serebrenik	Eindhoven University of Technology, The Netherlands
Tony Sloane	Macquarie University, Australia
Simão Melo de Sousa	Universidade da Beira Interior, Portugal
Tijs van der Storm	Centrum Wiskunde & Informatica, The Netherlands
James Terwilliger	Microsoft Corporation, USA
Laurence Tratt	King's College London, UK
Antonio Vallecillo	Universidad de Málaga, Spain
Eric Van Wyk	University of Minnesota, USA
Jurgen Vinju	Centrum Wiskunde & Informatica, The Netherlands
Joost Visser	Radboud University Nijmegen, The Netherlands
Markus Völter	Independent
Tanja E.J. Vos	Universidad Politécnica de Valencia, Spain
Andreas Winter	Carl von Ossietzky University, Germany
Victor Winter	University of Nebraska at Omaha, USA
Andy Zaidman	Delft University of Technology, The Netherlands
Vadim Zaytsev	Universiteit van Amsterdam, The Netherlands

Sponsoring Institutions

HASLab
INESCTEC

INESCTEC
TECHNOLOGY & SCIENCE
ASSOCIATE LABORATORY
PORTUGAL

Universidade do Minho
Escola de Engenharia

NOVALINCS
LABORATORY FOR COMPUTER
SCIENCE AND INFORMATICS

FACULDADE DE
CIÊNCIAS E TECNOLOGIA
UNIVERSIDADE NOVA DE LISBOA

UNIVERSITÄT
KOBLENZ · LANDAU

UNIVERSIDADE NOVA DE LISBOA

Contents

Probabilistic Program Analysis 1
Matthew B. Dwyer, Antonio Filieri, Jaco Geldenhuys, Mitchell Gerrard, Corina S. Păsăreanu, and Willem Visser

How Ontologies Can Help in Software Engineering 26
Cesar Gonzalez-Perez

Empirical, Human-Centered Evaluation of Programming and Programming Language Constructs: Controlled Experiments 45
Stefan Hanenberg

To Merge or Not to Merge: Managing Software Product Families 73
Julia Rubin

DSLs in Robotics: A Case Study in Programming Self-reconfigurable Robots 98
Ulrik Pagh Schultz, Mirko Bordignon, Kasper Stoy, Arne Nordmann, Nico Hochgeschwender, and Sebastian Wrede

People Analytics in Software Development 124
Leif Singer, Margaret-Anne Storey, Fernando Figueira Filho, Alexey Zagalsky, and Daniel M. German

Structured Program Generation Techniques 154
Yannis Smaragdakis, Aggelos Biboudis, and George Fourtounis

Refactoring Tools and Their Kin 179
Friedrich Steimann

Implementing a Linear Algebra Approach to Data Processing 215
Rogério Pontes, Miguel Matos, José Nuno Oliveira, and José Orlando Pereira

STRAF: A Scala Framework for Experiments in Trace-Based JIT Compilation 223
Maarten Vandercammen, Quentin Stiévenart, Wolfgang De Meuter, and Coen De Roover

Author Index 235