

*Commenced Publication in 1973*

Founding and Former Series Editors:

Gerhard Goos, Juris Hartmanis, and Jan van Leeuwen

## Editorial Board

David Hutchison

*Lancaster University, UK*

Takeo Kanade

*Carnegie Mellon University, Pittsburgh, PA, USA*

Josef Kittler

*University of Surrey, Guildford, UK*

Jon M. Kleinberg

*Cornell University, Ithaca, NY, USA*

Alfred Kobsa

*University of California, Irvine, CA, USA*

Friedemann Mattern

*ETH Zurich, Switzerland*

John C. Mitchell

*Stanford University, CA, USA*

Moni Naor

*Weizmann Institute of Science, Rehovot, Israel*

Oscar Nierstrasz

*University of Bern, Switzerland*

C. Pandu Rangan

*Indian Institute of Technology, Madras, India*

Bernhard Steffen

*TU Dortmund University, Germany*

Madhu Sudan

*Microsoft Research, Cambridge, MA, USA*

Demetri Terzopoulos

*University of California, Los Angeles, CA, USA*

Doug Tygar

*University of California, Berkeley, CA, USA*

Gerhard Weikum

*Max Planck Institute for Informatics, Saarbruecken, Germany*

João M. Fernandes Ralf Lämmel  
Joost Visser João Saraiva (Eds.)

# Generative and Transformational Techniques in Software Engineering III

International Summer School, GTTSE 2009  
Braga, Portugal, July 6-11, 2009  
Revised Papers

Volume Editors

João M. Fernandes  
João Saraiva  
Universidade do Minho  
Departamento de Informática  
Campus de Gualtar, 4710-057 Braga, Portugal  
E-mail: {jmf,jas}@di.uminho.pt

Ralf Lämmel  
Universität Koblenz-Landau  
FB 4, Institut für Informatik  
B127, Universitätsstraße 1, 56070 Koblenz, Germany  
E-mail: rlaemmel@gmail.com

Joost Visser  
Software Improvement Group  
A.J. Ernststraat 595-H, 1082 LD Amsterdam, The Netherlands  
E-mail: j.visser@sig.nl

Library of Congress Control Number: 2010941367

CR Subject Classification (1998): D.2, D.3, F.3, D.1, F.4.2, D.2.1

LNCS Sublibrary: SL 2 – Programming and Software Engineering

ISSN 0302-9743  
ISBN-10 3-642-18022-1 Springer Berlin Heidelberg New York  
ISBN-13 978-3-642-18022-4 Springer Berlin Heidelberg New York

This work is subject to copyright. All rights are reserved, whether the whole or part of the material is concerned, specifically the rights of translation, reprinting, re-use of illustrations, recitation, broadcasting, reproduction on microfilms or in any other way, and storage in data banks. Duplication of this publication or parts thereof is permitted only under the provisions of the German Copyright Law of September 9, 1965, in its current version, and permission for use must always be obtained from Springer. Violations are liable to prosecution under the German Copyright Law.

springer.com

© Springer-Verlag Berlin Heidelberg 2011  
Printed in Germany

Typesetting: Camera-ready by author, data conversion by Scientific Publishing Services, Chennai, India  
Printed on acid-free paper 06/3180

# Preface

The third instance of the international summer school on Generative and Transformational Techniques in Software Engineering (GTTSE 2009) was held in Braga, Portugal, July 6–11, 2009. In this volume, you find revised and extended lecture notes for most of the long and short summer-school tutorials as well as a small number of peer-reviewed papers that originated from the participants' workshop.

The mission of the GTTSE summer school series is to bring together PhD students, lecturers, as well as other researchers and practitioners who are interested in the generation and the transformation of programs, data, models, metamodels, documentation, and entire software systems. This mission crosscuts many areas of software engineering, e.g., software reverse and re-engineering, model-driven engineering, automated software engineering, generic language technology, software language engineering—to name a few. These areas differ in interesting ways, for example, with regard to the specific sorts of metamodels (or grammars, schemas, formats, etc.) that underlie the involved artifacts, and with regard to the specific techniques that are employed for the generation and the transformation of the artifacts.

The first two instances of the school were held in 2005 and 2007, and their post-proceedings appeared as volumes 4143 and 5235 in Springer's *LNCS* series.

The 2009 instance of GTTSE offered eight long tutorials, given by renowned representatives of complementary approaches and problem domains. Each tutorial combined foundations, methods, examples, and tool support. The program of the summer school featured another six short(er) tutorials, which presented more specific contributions to generative and transformational techniques. All tutorial presentations were invited by the organizers to complement each other in terms of the chosen application domains, case studies, and the underlying concepts. Yet another module in the program was a Research 2.0 event which combined tutorial-like aspects with a great discussion.

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

The program of the school remains available online.<sup>1</sup>

This volume contains revised and extended lecture notes for most of the long and short summer-school tutorials as well as a small number of peer-reviewed

---

<sup>1</sup> <http://gttse.wikidot.com/2009>

papers that originated from the participants' workshop. Each of the included seven long tutorial papers was reviewed by two members of the Scientific Committee of GTTSE 2009. Each of the included six short tutorial papers was reviewed by three members. The tutorial papers were primarily reviewed to help the authors with compiling original, readable and useful lecture notes. The three included participant contributions were peer-reviewed with three reviews per paper. For all papers, two rounds of reviewing and revision 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.

The next edition of GTTSE, GTTSE 2011, will be organized in Braga again, and it will be co-located with the 4th International Conference on Software Language Engineering. This co-location will provide for excellent synergies.

October 2010

João M. Fernandes  
Ralf Lämmel  
João Saraiva  
Joost Visser



## Organizing Committee

João Paulo Fernandes	Universidade do Minho, Braga, Portugal
Ralf Lämmel	Universität Koblenz-Landau, Germany
João Saraiva	Universidade do Minho, Braga, Portugal
Joost Visser	Software Improvement Group, Amsterdam, The Netherlands
Vadim Zaytsev	Universität Koblenz-Landau, Germany

## Sponsoring Institutions

Universität Koblenz-Landau  
Departamento de Informática, Universidade do Minho  
Centro de Ciências e Tecnologias de Computação  
Fundação para a Ciência e a Tecnologia  
Luso-American Foundation  
Software Improvement Group  
Efacec  
Multicert



# Table of Contents

## Part I – Long Tutorials

An Introduction to Software Product Line Refactoring . . . . .	1
<i>Paulo Borba</i>	
Excerpts from the TXL Cookbook . . . . .	27
<i>James R. Cordy</i>	
Model Synchronization: Mappings, Tiles, and Categories . . . . .	92
<i>Zinovy Diskin</i>	
An Introductory Tutorial on JastAdd Attribute Grammars . . . . .	166
<i>Görel Hedin</i>	
Model Driven Language Engineering with Kermeta . . . . .	201
<i>Jean-Marc Jézéquel, Olivier Barais, and Franck Fleurey</i>	
EASY Meta-programming with Rascal . . . . .	222
<i>Paul Klint, Tijs van der Storm, and Jurgen Vinju</i>	
The Theory and Practice of Modeling Language Design for Model-Based Software Engineering—A Personal Perspective . . . . .	290
<i>Bran Selic</i>	

## Part II – Short Tutorials

Code Transformations for Embedded Reconfigurable Computing Architectures . . . . .	322
<i>Pedro C. Diniz and João M.P. Cardoso</i>	
Model Transformation Chains and Model Management for End-to-End Performance Decision Support . . . . .	345
<i>Mathias Fritzsche and Wasif Gilani</i>	
Building Code Generators with Genesys: A Tutorial Introduction . . . . .	364
<i>Sven Jörges, Bernhard Steffen, and Tiziana Margaria</i>	
The Need for Early Aspects . . . . .	386
<i>Ana Moreira and João Araújo</i>	
Lightweight Language Processing in Kiama . . . . .	408
<i>Anthony M. Sloane</i>	



Some Issues in the ‘Archaeology’ of Software Evolution . . . . . 426  
*Michel Wermelinger and Yijun Yu*

**Part III – Participants Contributions**

Teaching Computer Language Handling – From Compiler Theory to  
Meta-modelling . . . . . 446  
*Terje Gjørseter and Andreas Prinz*

C++ Metastring Library and Its Applications . . . . . 461  
*Zalán Szűgyi, Ábel Sinkovics, Norbert Pataki, and Zoltán Porkoláb*

Language Convergence Infrastructure . . . . . 481  
*Vadim Zaytsev*

**Author Index** . . . . . 499