Formal Foundations For Software Engineering Methods

Gerard O'Regan

Formal Foundations for Software Engineering Methods Heinrich Hußmann,1997-09-23 In this book, Hussmann builds a bridge between the pragmatic methods for the design of information systems and the formal, mathematical background. Firstly, the principal feasibility of an integration of the different methods is demonstrated. Secondly, the formalism is used as a systematic semantic analysis of the concepts in SSADM, a British standard structured software engineering method. Thirdly, a way of obtaining a hybrid formal-pragmatic specification using a combination of SSADM notations and formal (SPECTRUM) specifications is shown. This well-written book encourages scientists and software engineers to apply formal methods to practical software development problems.

Formal Methods for Software Engineering Markus Roggenbach,Antonio Cerone,Bernd-Holger Schlingloff,Gerardo Schneider,Siraj Ahmed Shaikh,2022-06-22 Software programs are formal entities with precise meanings independent of their programmers, so the transition from ideas to programs necessarily involves a formalisation at some point. The first part of this graduate-level introduction to formal methods develops an understanding of what constitutes formal methods and what their place is in Software Engineering. It also introduces logics as languages to describe reasoning and the process algebra CSP as a language to represent behaviours. The second part offers specification and testing methods for formal development of software, based on the modelling languages CASL and UML. The third part takes the reader into the application domains of normative documents, human machine interfaces, and security. Use of notations and formalisms is uniform throughout the book. Topics and features: Explains foundations, and introduces specification, verification, and testing methods Explores various application domains Presents realistic and practical examples, illustrating concepts Brings together contributions from highly experienced educators and researchers Offers modelling and analysis methods for formal development of software Suitable for graduate and undergraduate courses in software engineering, this uniquely practical textbook will also be of value to students in informatics, as well as to scientists and practical engineers, who want to learn about or work more effectively with formal theories and methods. Markus Roggenbach is a Professor in the Dept. of Computer Science of Swansea University. Antonio Cerone is an Associate Professor in the Dept. of Computer Science of Nazarbayev University, Nur-Sultan. Bernd-Holger Schlingloff is a Professor in the Institut für Informatik of Humboldt-Universität zu Berlin. Gerardo Schneider is a Professor in the Dept. of Computer Science and Engineering of University of Gothenburg. Siraj Ahmed Shaikh
is a Professor in the Institute for Future Transport and Cities of Coventry University. The companion site for the book offers additional resources, including further material for selected chapters, prepared lab classes, a list of errata, slides and teaching material, and virtual machines with preinstalled tools and resources for hands-on experience with examples from the book. The URL is: https://sefm-book.github.io

Software Engineering Foundations Yingxu Wang, 2007-08-09 A groundbreaking book in this field, Software Engineering Foundations: A Software Science Perspective integrates the latest research, methodologies, and their applications into a unified theoretical framework. Based on the author's 30 years of experience, it examines a wide range of underlying theories from philosophy, cognitive informatics, denota

Software Engineering and Formal Methods Steve Counsell, Manuel Núñez, 2014-07-08 This book constitutes the revised selected papers of the collocated workshops of the 11th International Conference on Software Engineering and Formal Methods, SEFM 2013, held in Madrid, Spain, in September 2013. The conference hosted 5 workshops: The Second International Workshop on Behavioural Types (BEAT2). The aim was to pursue research topics in the use of behavioural type theory as the basis for new foundations, programming languages and software development methods for communication-intensive distributed systems. The Third Workshop on Formal Methods in the Development of Software (WS-FMDS). The aim was to bring together scientists and practitioners active in the area of formal methods and interested in exchanging their experiences in the industrial usage of these methods. The Workshop on a Formal Methods Body of Knowledge for Railway Control and Safety Systems (FM-RAIL-BOK). In many engineering-based application areas such as in the railway domain, formal methods have reached a level of maturity that already enables the compilation of a so-called body of knowledge. The Second International Symposium on Modelling and Knowledge Management for Sustainable Development (MoKMaSD). The aim was to bring together researchers and practitioner from academia, industry, government and non-government organisations to present research results and exchange experience, ideas and solutions for modelling and analysing complex systems. In particular in areas including economy, governance, health, biology, ecology, climate and poverty reduction. The 7th International Workshop on Foundations and Techniques for Open Source Software Certification (Open Cert). The aim was to bring together researchers from Academia and Industry interested in the quality assessment of OSS projects, as well as the metrics, procedures and tools used in OSS communities and for the measurement and assessment of OSS quality.

Foundations of Algebraic Specification and Formal Software Development Donald Sannella, Andrzej Tarlecki, 2012-01-05 This book provides foundations for software specification and formal software development from the perspective of work on algebraic specification, concentrating on developing basic concepts and studying their fundamental properties. These foundations are built on a solid mathematical basis, using elements of universal algebra, category theory and logic, and this mathematical toolbox provides a convenient language for precisely formulating the concepts involved in software
specification and development. Once formally defined, these notions become subject to mathematical investigation, and this interplay between mathematics and software engineering yields results that are mathematically interesting, conceptually revealing, and practically useful. The theory presented by the authors has its origins in work on algebraic specifications that started in the early 1970s, and their treatment is comprehensive. This book contains five kinds of material: the requisite mathematical foundations; traditional algebraic specifications; elements of the theory of institutions; formal specification and development; and proof methods. While the book is self-contained, mathematical maturity and familiarity with the problems of software engineering is required; and in the examples that directly relate to programming, the authors assume acquaintance with the concepts of functional programming. The book will be of value to researchers and advanced graduate students in the areas of programming and theoretical computer science.

*Formal Methods and Software Engineering* Stephan Merz, Jun Pang, 2014-10-15 This book constitutes the refereed proceedings of the 16th International Conference on Formal Engineering Methods, ICFEM 2014, held in Luxembourg, Luxembourg, in November 2014. The 28 revised full papers presented were carefully reviewed and selected from 73 submissions. The papers cover a wide range of topics in the area of formal methods and software engineering and are devoted to advancing the state of the art of applying formal methods in practice. They focus in particular on combinations of conceptual and methodological aspects with their formal foundation and tool support.

*Foundations of Software Engineering* Ashfaque Ahmed, Bhanu Prasad, 2016-08-25 The best way to learn software engineering is by understanding its core and peripheral areas. Foundations of Software Engineering provides in-depth coverage of the areas of software engineering that are essential for becoming proficient in the field. The book devotes a complete chapter to each of the core areas. Several peripheral areas are also explained by assigning a separate chapter to each of them. Rather than using UML or other formal notations, the content in this book is explained in easy-to-understand language. Basic programming knowledge using an object-oriented language is helpful to understand the material in this book. The knowledge gained from this book can be readily used in other relevant courses or in real-world software development environments. This textbook educates students in software engineering principles. It covers almost all facets of software engineering, including requirement engineering, system specifications, system modeling, system architecture, system implementation, and system testing. Emphasizing practical issues, such as feasibility studies, this book explains how to add and develop software requirements to evolve software systems. This book was written after receiving feedback from several professors and software engineers. What resulted is a textbook on software engineering that not only covers the theory of software engineering but also presents real-world insights to aid students in proper implementation. Students learn key concepts through carefully explained and illustrated theories, as well as concrete examples and a complete case study using Java. Source code is also available on the book’s website. The examples and case studies increase in complexity as the
book progresses to help students build a practical understanding of the required theories and applications.

**Formal Methods and Software Engineering** Michael Butler, Sylvain Conchon, Fatiha Zaïdi, 2015-11-30 This book constitutes the refereed proceedings of the 17th International Conference on Formal Engineering Methods, ICFEM 2015, held in Paris, France, in November 2015. The 27 revised full papers presented were carefully reviewed and selected from 82 submissions. The papers cover a wide range of topics in the area of formal methods and software engineering and are devoted to advancing the state of the art of applying formal methods in practice. They focus in particular on combinations of conceptual and methodological aspects with their formal foundation and tool support.

**Formal Foundations of Reuse and Domain Engineering** Stephen H. Edwards, Gregory Kulczycki, 2009-09-11 This book constitutes the refereed proceedings of the 11th International Conference on Software Reuse, ICSR 2009, held in Falls Church, VA, USA, in September 2009. The 28 full papers were carefully selected from numerous submissions. 2009 was the year that ICSR went back to its roots. The theme was Formal Foundations of Reuse and Domain Engineering. The theory and formal foundations that underlie current reuse and domain engineering practice were explored and current advancements to get an idea of where the field of reuse was headed, were looked at. Many of the papers in these proceedings reflect that theme, e.g. component reuse and verification, feature modeling, generators and model-driven development, industry experience, product lines, reuse and patterns, service-oriented environments.

**Software Engineering and Formal Methods** Carlos Canal, Akram Idani, 2015-01-31 This book constitutes revised selected papers from the workshops collocated with the SEFM 2014 conference on Software Engineering and Formal Methods, held in Grenoble, France, in September 2014. The 26 papers included in this volume were carefully reviewed and selected from 49 submissions. They are from the following workshops: the 1st Workshop on Human-Oriented Formal Methods - From Readability to Automation, HOFM 2014, the 3rd International Symposium on Modelling and Knowledge Management Applications - Systems and Domains, MoKMaSD 2014, the 8th International Workshop on Foundations and Techniques for Open Source Software Certification, Open Cert 2014, the 1st Workshop on Safety and Formal Methods, SaFoMe 2014 and the 4th Workshop on Formal Methods in the Development of Software, WS-FMDS 2014.

**Mathematical Foundations of Software Engineering** Gerard O'Regan, 2023-05-04 This textbook presents an introduction to the mathematical foundations of software engineering. It presents the rich applications of mathematics in areas such as error-correcting codes, cryptography, the safety and security critical fields, the banking and insurance fields, as well as traditional engineering applications. Topics and features: Addresses core mathematics for critical thinking and problem solving Discusses propositional and predicate logic and various proof techniques to demonstrate the correctness of a logical argument. Examines number theory and its applications to cryptography Considers the underlying mathematics of error-correcting codes Discusses graph theory and its applications to modelling networks Reviews tools to support software
engineering mathematics, including automated and interactive theorem provers and model checking. Discusses financial software engineering, including simple and compound interest, probability and statistics, and operations research. Discusses software reliability and dependability and explains formal methods used to derive a program from its specification. Discusses calculus, matrices, vectors, complex numbers, and quaternions, as well as applications to graphics and robotics. Includes key learning topics, summaries, and review questions in each chapter, together with a useful glossary. This practical and easy-to-follow textbook/reference is ideal for computer science students seeking to learn how mathematics can assist them in building high-quality and reliable software on time and on budget. The text also serves as an excellent self-study primer for software engineers, quality professionals, and software managers.

**Formal Methods and Software Engineering** Michael Butler, Sylvain Conchon, Fatiha Zaïdi, 2015

This book constitutes the refereed proceedings of the 17th International Conference on Formal Engineering Methods, ICFEM 2015, held in Paris, France, in November 2015. The 27 revised full papers presented were carefully reviewed and selected from 82 submissions. The papers cover a wide range of topics in the area of formal methods and software engineering and are devoted to advancing the state of the art of applying formal methods in practice. They focus in particular on combinations of conceptual and methodological aspects with their formal foundation and tool support.

**Formal Methods in Systems Engineering** Peter Ryan, Chris Sennett, 2012

As computer technology is used to control critical systems to an increasing degree, it is vital that the methods for developing and understanding these systems are substantially improved. The mathematical and scientific foundations currently used are extremely limited which means that their correctness and reliability cannot be ensured to an acceptable level. Systems engineering needs to become a fully fledged scientific discipline and formal methods, which are characterised by their firm mathematical foundations, are playing a vital role in achieving this transition. This volume is based on the proceedings of the Formal Methods Workshop (FM91), held in Drymen, Scotland, 24-27 September 1991. This was the second workshop sponsored by the Canadian and US governments to address the role of formal methods in the development of digital systems. Traditionally, formal methods have evolved in isolation from more conventional approaches, and one of the aims of this workshop was to emphasise the benefits of integrating the two areas. The workshop concentrated on the themes of quality assurance, design methods and mathematical modelling techniques. Particular emphasis was given to safety and security applications. Among the topics covered in this volume are: what is a formal method?; social research on formal methods; current quality assurance methods and formal methods; a pragmatic approach to validation; integrating methods in practice; composition of descriptions; and topics in large program formal development. Formal Methods in Systems Engineering provides an overview of many of the major approaches to formal methods and the benefits which can result from them. It is relevant to academic and industrial researchers, industrial practitioners and government workers with an interest in certification.
Engineering Theories of Software Intensive Systems  Manfred Broy, Johannes Gruenbauer, David Harel, Tony Hoare, 2005-07-15 Software engineering has over the years been applied in many different fields, ranging from telecommunications to embedded systems in car and aircraft industry as well as in production engineering and computer networks. Foundations in software technology lie in models allowing to capture application domains, detailed requirements, but also to understand the structure and working of software systems like software architectures and programs. These models have to be expressed in techniques based on discrete mathematics, algebra and logics. However, according to the very specific needs in applications of software technology, formal methods have to serve the needs and the quality of advanced software engineering methods, especially taking into account security aspects in Information Technology. This book presents mathematical foundations of software engineering and state-of-the-art engineering methods in their theoretical substance in the step towards practical applications to examine software engineering techniques and foundations used for industrial tasks. The contributions in this volume emerged from lectures of the 25th International Summer School on Engineering Theories of Software Intensive Systems, held at Marktoberdorf, Germany from August 3 to August 15, 2004.

Formal Methods and Software Engineering  Toshiaki Aoki, Kenji Taguchi, 2012-10-29 This book constitutes the refereed proceedings of the 14th International Conference on Formal Engineering Methods, ICFEM 2012, held in Kyoto, Japan, November 2012. The 31 revised full papers together with 3 invited talks presented were carefully reviewed and selected from 85 submissions. The papers address all current issues in formal methods and their applications in software engineering. They are organized in topical sections on concurrency, applications of formal methods to new areas, quantity and probability, formal verification, modeling and development methodology, temporal logics, abstraction and refinement, tools, as well as testing and runtime verification.

Formal Methods for Eternal Networked Software Systems  Marco Bernardo, Valerie Issarny, 2011-06-03 This book presents 15 tutorial lectures by leading researchers given at the 11th edition of the International School on Formal Methods for the Design of Computer, Communication and Software Systems, SFM 2011, held in Bertinoro, Italy, in June 2011. SFM 2011 was devoted to formal methods for eternal networked software systems and covered several topics including formal foundations for the inter-operability of software systems, application-layer and middleware-layer dynamic connector synthesis, interaction behavior monitoring and learning, and quality assurance of connected systems. The school was held in collaboration with the researchers of the EU-funded projects CONNECT and ETERNALS. The papers are organized into six parts: (i) architecture and interoperability, (ii) formal foundations for connectors, (iii) connector synthesis, (iv) learning and monitoring, (v) dependability assurance, and (vi) trustworthy eternal systems via evolving software.

Graph Transformation for Software Engineers  Reiko Heckel, Gabriele Taentzer, 2020-05-13 This book is an introduction to graph transformation as a foundation to model-based software engineering at the level of both individual
systems and domain-specific modelling languages. The first part of the book presents the fundamentals in a precise, yet largely informal way. Besides serving as prerequisite for describing the applications in the second part, it also provides a comprehensive and systematic survey of the concepts, notations and techniques of graph transformation. The second part presents and discusses a range of applications to both model-based software engineering and domain-specific language engineering. The variety of these applications demonstrates how broadly graphs and graph transformations can be used to model, analyse and implement complex software systems and languages. This is the first textbook that explains the most commonly used concepts, notations, techniques and applications of graph transformation without focusing on one particular mathematical representation or implementation approach. Emphasising the research and engineering methodologies used, it will be a valuable resource for graduate students, practitioners and researchers in software engineering, foundations of programming and formal methods.

Foundations of Empirical Software Engineering  
Barry Boehm, Hans Dieter Rombach, Marvin V. Zelkowitz, 2005-05-13

Although software engineering can trace its beginnings to a NATO conference in 1968, it cannot be said to have become an empirical science until the 1970s with the advent of the work of Prof. Victor Robert Basili of the University of Maryland. In addition to the need to engineer software was the need to understand software. Much like other sciences, such as physics, chemistry, and biology, software engineering needed a discipline of observation, theory formation, experimentation, and feedback. By applying the scientific method to the software engineering domain, Basili developed concepts like the Goal-Question-Metric method, the Quality-Improvement-Paradigm, and the Experience Factory to help bring a sense of order to the ad hoc developments so prevalent in the software engineering field. On the occasion of Basili’s 65th birthday, we present this book containing reprints of 20 papers that defined much of his work. We divided the 20 papers into 6 sections, each describing a different facet of his work, and asked several individuals to write an introduction to each section. Instead of describing the scope of this book in this preface, we decided to let one of his papers, the keynote paper he gave at the International Conference on Software Engineering in 1996 in Berlin, Germany to lead off this book. He, better than we, can best describe his views on what is - perimental software engineering.

Software Engineering and Formal Methods  
Javier Camara, Martin Steffen, 2020-09-09

The volume LNCS 12226 constitutes the revised selected papers from the four workshops collocated with the 17th International Conference on Software Engineering and Formal Methods, SEFM 2019. The 13 full papers presented together with 7 short papers in this volume were carefully reviewed and selected from a total of 45 submissions. They stem from the following workshops: CoSim-CPS 2019 - 3rd International Workshop on Formal Co-Simulation of Cyber-Physical Systems; ASYDE 2019 -- 1st International Workshop on Cognition: Interdisciplinary Foundations, Models and Applications; and FOCLASA 2019 -- 17th International Workshop on Foundations of Coordination Languages and Self-Adaptive Systems.
Formal Methods: Foundations and Applications Tiago Massoni, Mohammad Reza Mousavi, 2018-11-19 This book constitutes the refereed proceedings of the 21st Brazilian Symposium on Formal Methods, SBMF 2018, which took place in Salvador, Brazil, in November 2018. The 16 regular papers presented in this book were carefully reviewed and selected from 30 submissions. The papers are organized in topical sections such as: techniques and methodologies; specification and modeling languages; theoretical foundations; verification and validation; experience reports regarding teaching formal methods; and applications. Chapter “TeSSLa: Temporal Stream-Based Specification Language” is available open access under a Creative Commons Attribution 4.0 International License via link.springer.com.

Reviewing Formal Foundations For Software Engineering Methods: Unlocking the Spellbinding Force of Linguistics

In a fast-paced world fueled by information and interconnectivity, the spellbinding force of linguistics has acquired newfound prominence. Its capacity to evoke emotions, stimulate contemplation, and stimulate metamorphosis is actually astonishing. Within the pages of "Formal Foundations For Software Engineering Methods," an enthralling opus penned by a highly acclaimed wordsmith, readers embark on an immersive expedition to unravel the intricate significance of language and its indelible imprint on our lives. Throughout this assessment, we shall delve to the book is central motifs, appraise its distinctive narrative style, and gauge its overarching influence on the minds of its readers.

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Formal Foundations For Software Engineering Methods Introduction

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