Composing Features and Resolving Interactions

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ABSTRACT

One of the accepted techniques for developing and maintaining feature-rich applications is to treat each feature as a separate concern. However, most features are not separate concerns because they override and extend the same basic service. That is, "independent" features are coupled to one another through the system's basic service. As a result, seemingly unrelated features subtly interfere with each other when trying to override the system behaviour in different directions. The problem is how to coordinate features' access to the service's shared variables.

This paper proposes coordinating features via feature composition. We model each feature as a separate labelled-transition system and define a *conflict-free* (CF) composition operator that prevents enabled transitions from synchronizing if they interact: if several features' transitions are simultaneously enabled but have conflicting actions, a non-conflicting subset of the enabled transitions are synchronized in the composition. We also define a *conflict-and violation-free* (CVF) composition operator that prevents enabled transitions from executing if they violate features' invariants. Both composition operators use priorities among features to decide whether to synchronize transitions.

Categories and Subject Descriptors

F.3.1 [**Logics and Meanings of Programs**]: Specifying and Verifying and Reasoning about Programs—*Specification techniques, Assertions, Invariants*; F.3.2 [**Logics and Meanings of Programs**]: Semantics of Programming Languages—*process models*; D.2.12 [**Software Engineering**]: Interoperability; D.2.11 [**Software Engineering**]: Software Architecture—*domain-specific architectures*

General Terms

Design

Keywords

Modularity, incremental programming, feature interaction, conflict resolution

1. INTRODUCTION

Software engineering techniques such as separation of concerns and incremental programming help software developers to build feature-rich applications by allowing them to consider new features as independent increments of the application's basic service. However, separately developed features can subtly interfere with each other because they enhance the same basic service and manipulate the same service variables. In general, a *feature interaction* occurs whenever one feature affects the behaviour of another [11].

Not all interactions are bad. Many are planned. For example, features are designed to interact with the basic service and any features that they override and extend. Conflicts occur when seemingly unrelated features trip over each other while trying to simultaneously override system behaviour. The problem is that while features are treated as separate concerns, they are coupled to one another through the service that they extend and their access to the shared service is not well coordinated.

The *feature interaction problem* is how to rapidly develop and deploy new features without disrupting the functionality of existing features. Approaches to this problem include the following

Eliminating interactions during design. The idea is to formally specify features as separate entities, compose the specifications, search the composition for interactions, and resolve interactions by modifying the feature specifications [1, 3, 6, 8, 15, 24]. However, features cannot be re-designed *independently* to eliminate interactions. Also, if the system is evolving, many of the features under consideration may already be implemented and not open to re-design [30]. Instead, most design-time resolutions specify how groups of features behave together, either by adding exception clauses to features [3, 29], adding supervisors that explicitly interleave the actions of feature combinations [2, 26], adding rules or features that explicitly define the behaviour of feature combinations [5, 29], etc. The problem with such resolution techniques is that they don't scale to systems that have hundreds or thousands of features because the number of feature combinations to consider grows exponentially. Worse, by specifying the behaviour of feature combinations, they counteract the benefits of separation of concerns, making it difficult to resolve interactions with future features or to customize resolutions to an individual user's needs.

Preventing interactions via architectural constraints. An architecture can help avoid interactions by constraining and coordinating the features' access to the service's variables and resources. Distributed Feature Coordination (DFC) [20] organizes features in a pipe-and-filter architecture where the messages that are passed among the features act as tokens that

Resolving Interactions

Danielle L. Lupton

Resolving Interactions:

   Feature Interactions in Telecommunications Systems, III Kong E. Cheng,Tadashi Ohta,1995 In an information society heavily dependent on communications and distributed systems feature interactions are likely to become an even more important problem than they are today A particularly interesting issue given the current work on agents is whether feature interactions will be more likely in systems with many autonomous agents performing tasks The current demand for better and more convenient communications requires development of a variety of new services as quickly as possible As the number of services becomes larger however feature interactions create incompatibilities between the various functions needed to implement them In developing telecommunication systems we now spend huge numbers of person hours on software modifications and testing whenever a new function is added Much of this time is spent on detecting and eliminating problems arising from feature interaction In the future as ever more services are offered feature interactions will become a major bottleneck in the development of software for telecommunications systems This book presents opinions on the technical problems involved in feature interactions and definitions of features and feature interactions   Protein-Nucleic Acid Interactions Phoebe A Rice,Carl C Correll,2008-04-22 The structural biology of protein nucleic acid interactions is in some ways a mature field and in others in its infancy High resolution structures of protein DNA complexes have been studied since the mid 1980s and a vast array of such structures has now been determined but surprising and novel structures still appear quite frequently High resolution structures of protein RNA complexes were relatively rare until the last decade Propelled by advances in technology as well as the realization of RNA s importance to biology the number of example structures has ballooned in recent years New insights are now being gained from comparative studies only recently made possible due to the size of the database as well as from careful biochemical and biophysical studies As a result of the explosion of research in this area it is no longer possible to write a comprehensive review Instead current review articles tend to focus on particular subtopics of interest This makes it difficult for newcomers to the field to attain a solid understanding of the basics One goal of this book is therefore to provide in depth discussions of the fundamental principles of protein nucleic acid interactions as well as to illustrate those fundamentals with up to date and fascinating examples for those who already possess some familiarity with the field The book also aims to bridge the gap between the DNA and the RNA views of nucleic acid protein recognition which are often treated as separate fields However this is a false dichotomy because protein DNA and protein RNA interactions share many general principles This book therefore includes relevant examples from both sides and frames discussions of the fundamentals in terms that are relevant to both The monograph approaches the study of protein nucleic acid interactions in two distinctive ways First DNA protein and RNA protein interactions are presented together Second the first half of the book develops the principles of protein nucleic acid recognition whereas the second half applies these to more specialized topics Both halves are illustrated with important real life examples The first half of the book develops

fundamental principles necessary to understand function An introductory chapter by the editors reviews the basics of nucleic acid structure Jen Jacobsen and Jacobsen discuss how solvent interactions play an important role in recognition illustrated with extensive thermodynamic data on restriction enzymes Marmorstein and Hong introduce the zoology of the DNA binding domains found in transcription factors and describe the combinational recognition strategies used by many multiprotein eukaryotic complexes Two chapters discuss indirect readout of DNA sequence in detail Berman and Lawson explain the basic principles and illustrate them with in depth studies of CAP while in their chapter on DNA bending and compaction Johnson Stella and Heiss highlight the intrinsic connections between DNA bending and indirect readout Horvath lays out the fundamentals of protein recognition of single stranded DNA and single stranded RNA and describes how they apply in a detailed analysis of telomere end binding proteins Nucleic acids adopt more complex structures Lilley describes the conformational properties of helical junctions and how proteins recognize and cleave them Because RNA readily folds due to the stabilizing role of its 2 hydroxyl groups Li discusses how proteins recognize different RNA folds which include duplex RNA With the fundamentals laid out discussion turns to more specialized examples taken from important aspects of nucleic acid metabolism Schroeder discusses how proteins chaperone RNA by rearranging its structure into a functional form Berger and Dong discuss how topoisomerases alter the topology of DNA and relieve the superhelical tension introduced by other processes such as replication and transcription Dyda and Hickman show how DNA transposes mediate genetic mobility and Van Duyne discusses how site specific recombinases cut and paste DNA Horton presents a comprehensive review of the structural families and chemical mechanisms of DNA nucleases whereas Li in her discussion of RNA protein recognition also covers RNA nucleases Lastly Ferr D Amar shows how proteins recognize and modify RNA transcripts at specific sites The book also emphasises the impact of structural biology on understanding how proteins interact with nucleic acids and it is intended for advanced students and established scientists wishing to broaden their horizons   Feature Interactions in Software and Communication Systems IX Lydie Du Bousquet,Jean-Luc Richier,2008 Deals with the feature interaction problem in telecommunication systems   Feature Interactions in Telecommunications and Software Systems VI Muffy Calder,Evan Magill,2000 Typically telecommunications services are implemented in software Feature interaction is the term used to describe interference between services or features most attention is given to cases where the interference is undesirable ie there is an incompatibility In telecommunications control and data is distributed and on such a large scale that software development is by numerous disjoint teams by its nature therefore this software experienced the feature interaction problem first But while the workshop focuses on communications services the subject has relevance to any domain where separate software entities control a shared resource   *10000+ ChatGPT Prompts for Digital Marketing Success* Nick Wishstone, Dive into the digital marketing revolution with 10000 ChatGPT Prompts for Digital Marketing Success Leveraging AI to Elevate Digital Marketing Efforts Generate More Leads and Close More Deals This comprehensive guide is your

indispensable resource for harnessing the power of AI in your marketing strategies offering a treasure trove of over 10 000 prompts designed to innovate your approach captivate your audience and skyrocket your sales In today s fast paced digital world staying ahead of the curve is crucial This book is meticulously crafted to help marketers entrepreneurs and businesses of all sizes break through the noise connect with their target audience more effectively and drive unparalleled growth Whether you re looking to refine your social media presence enhance your content strategy master paid advertising or explore the frontiers of AI in digital marketing this collection has something for everyone 10000 ChatGPT Prompts for Digital Marketing Success not only guides you through leveraging ChatGPT for content creation and strategy development but also dives deep into applying AI for analytical insights optimizing ad campaigns and personalizing customer experiences From organic reach and influencer marketing to the nuances of e commerce and lead generation this book covers the entire digital marketing spectrum Key Features Over 10 000 Innovative Prompts Unleash your creative potential and explore new strategies with prompts covering every aspect of digital marketing AI Powered Techniques Learn how to integrate AI tools like ChatGPT into your marketing efforts for analysis creativity and efficiency Comprehensive Digital Marketing Insights From social media to SEO paid advertising to email marketing get up to date tactics that work Practical Guides and Strategies Step by step guides on implementing the prompts and strategies to generate leads nurture them effectively and close more deals Adaptation to Various Niches Tailor these prompts to fit your specific industry needs ensuring relevance and impact Whether you re a seasoned digital marketer looking to enhance your toolkit or a newcomer eager to make your mark 10000 ChatGPT Prompts for Digital Marketing Success offers the insights and tools you need to succeed in the digital age Embrace the future of marketing let AI be your guide to reaching new heights of success and innovation

Intelligence in Networks Thongchai Yongchareon,Finn Arve Aagesen,Vilas Wuwongse,2012-12-06 Intelligence in Networks is a concept the meaning of which is highly related to the time period when it is used In the 1960s 1970s and 1980s it was mainly related to the teleservice repertoire an sich In the 1990s it is more related to efficient flexibility in the introduction of new teleservices and teleservice repertoire This state of the art text sets out to identify and study issues related to solutions for increasing intelligence in networks As examples intelligence networks IN telecommunication information networking architecture TINA and mobile agents and active networks are different solutions for improving the grade of network intelligence The areas under discussion include research and development within various closely related fields such as Teleservices service architecture and service creation Middleware and specification languages Mobile agents active networks plug and play issues and Quality of service and performance LIST Intelligence in Networks contains the proceedings of SMARTNET 99 the fifth in a series of conferences on intelligence in networks sponsored by the International Federation for Information Processing IFIP at the Asian Institute of Technology Pathumthani Thailand in November 1999

Computer Performance Evaluation Anthony J. Field,2002-04-03 This book constitutes the refereed proceedings of the

12th International Conference on Modelling Techniques and Tools for Computer Performance Evaluation TOOLS 2002 held in London UK in April 2002 The 18 revised full papers and six tool papers presented together with an invited contribution were carefully reviewed and selected from 57 submissions Among the topics addressed are generic techniques like stochastic process algebras and the analysis of Petri nets and Markov chains as well as the development and employment of tools in areas such as the Internet software performance engineering parallel systems real time systems and transaction processing

Runtime Verification Christian Colombo,Martin Leucker,2018-11-07 This book constitutes the refereed proceedings of the 18th International Conference on Runtime Verification RV 2018 held in Limassol Cyprus in November 2018 The 21 full papers presented together with 3 short papers and 3 tool papers were carefully reviewed and selected from 49 submissions The RV conference is concerned with all aspects of monitoring and analysis of hardware software and more general system executions Runtime verification techniques are lightweight techniques to assess correctness reliability and robustness these techniques are significantly more powerful and versatile than conventional testing and more practical than exhaustive formal verification Chapter Hardware based Runtime Verification with Embedded Tracing Units and Stream Processing is available open access under a Creative Commons Attribution 4 0 International License via link springer com **Computer Performance Evaluation: Modelling Techniques and Tools** Tony Field,Peter G. Harrison,Jeremy Bradley,Uli Harder,2003-08-01 This book constitutes the refereed proceedings of the 12th International Conference on Modelling Techniques and Tools for Computer Performance Evaluation TOOLS 2002 held in London UK in April 2002 The 18 revised full papers and six tool papers presented together with an invited contribution were carefully reviewed and selected from 57 submissions Among the topics addressed are generic techniques like stochastic process algebras and the analysis of Petri nets and Markov chains as well as the development and employment of tools in areas such as the Internet software performance engineering parallel systems real time systems and transaction processing *Mobile Agents for Telecommunication Applications* Samuel Pierre,Roch Glitho,2001-08-09 ofAppliedSciencesofWesternSwitzerland MATAWorkshop SteeringCommittee EricHorlait LIP6 France RogerImpey NRC Canada AhmedKarmouch UniversityofOttawa Canada ThomasMagedanz IKV GMD Germany Table of Contents DynamicCongestionAvoidanceUsingMulti agentSystems 1 N Rouhana E Horlait UseofAgentsforResolvingFeatureInteractions Feature Interactions in Telecommunications and Software Systems V K. Kimbler,L. G. Bouma,1998 The LabManual is a valuable tool designed to enhance your lab experience Lab activities objectives materials lists step by step procedures illustrations and review questions are commonly found in a Lab Manual **Feature Interactions in Telecommunications and Software Systems VIII** Stephan Reiff-Marganiec,Mark D. Ryan,2005 Features additional services occur whenever organisations compete by differentiating their products from those of rival organisations Adding one feature may break another or interfere with it in an undesired way This phenomenon is called feature interaction This book explores ways in which the feature interaction problem may be

mitigated   **Interaction Design for Complex Problem Solving** Barbara Mirel,2004 This book presents a groundbreaking approach to interaction design for complex problem solving applications   *Encyclopedia of Human Relationships* Harry T. Reis,Susan Sprecher,2009-03-15 Library Journal Best Reference 2009 An excellent gateway to further examination of any of the subdisciplines of relationship science or as a research tool in its own right Library Journal Relationships are fundamental to nearly all domains of human activity from birth to death When people participate in healthy satisfying relationships they live work and learn more effectively When relationships are distressed or dysfunctional people are less happy less healthy and less productive Few aspects of human experience have as broad or as deep effects on our lives The Encyclopedia of Human Relationships offers an interdisciplinary view of all types of human associations friends lovers spouses roommates coworkers teammates parents and children cousins siblings acquaintances neighbors business associates and so forth Although each of these connections is unique in some respect they share a common core of principles and processes These three volumes provide a state of the art review of the extensive theories concepts and empirical findings about human relationships Key Features Compiles leading edge information about how people think feel and act toward each other Presents the best in the field authors who have contributed significant scientific knowledge about personal relationships over the past several decades Offers a diverse approach to relationship science with contributions from psychology sociology communication family studies anthropology physiology neuroscience history economics and legal studies Key Themes Cognitive Processes in Relationships Communication Processes Creating and Maintaining Closeness Dating Courtship and Marriage The Dark Side of Relationships Emotion Processes in Relationships Family Friendship and Caregiving in Adulthood Health and the Biology of Relationships Methods for Studying Relationships Personality and Individual Differences Prevention and Repair of Relationship Problems Psychological Processes Sexuality Social Context of Relationships Social Relations in Childhood and Adolescence Theoretical Approaches to Studying Relationships Types of Relationships Our relationships influence virtually all aspects of our everyday existence and are of deep interest to students researchers academics and laypeople alike This Encyclopedia is an invaluable addition to any academic or public library   **Reputation for Resolve** Danielle L. Lupton,2020-04-15 How do reputations form in international politics What influence do these reputations have on the conduct of international affairs In Reputation for Resolve Danielle L Lupton takes a new approach to answering these enduring and hotly debated questions by shifting the focus away from the reputations of countries and instead examining the reputations of individual leaders Lupton argues that new leaders establish personal reputations for resolve that are separate from the reputations of their predecessors and from the reputations of their states Using innovative survey experiments and in depth archival research she finds that leaders acquire personal reputations for resolve based on their foreign policy statements and behavior Reputation for Resolve shows that statements create expectations of how leaders will react to foreign policy crises in the future and that leaders who fail to meet expectations of resolute action face

harsh reputational consequences Reputation for Resolve challenges the view that reputations do not matter in international politics In sharp contrast Lupton shows that the reputations for resolve of individual leaders influence the strategies statesmen pursue during diplomatic interactions and crises and she delineates specific steps policymakers can take to avoid developing reputations for irresolute action Lupton demonstrates that reputations for resolve do exist and can influence the conduct of international security Thus Reputation for Resolve reframes our understanding of the influence of leaders and their rhetoric on crisis bargaining and the role reputations play in international politics **Intelligent Autonomous Systems 13** Emanuele Menegatti,Nathan Michael,Karsten Berns,Hiroaki Yamaguchi,2015-09-03 This book describes the latest research accomplishments innovations and visions in the field of robotics as presented at the 13th International Conference on Intelligent Autonomous Systems IAS held in Padua in July 2014 by leading researchers engineers and practitioners from across the world The contents amply confirm that robots machines and systems are rapidly achieving intelligence and autonomy mastering more and more capabilities such as mobility and manipulation sensing and perception reasoning and decision making A wide range of research results and applications are covered and particular attention is paid to the emerging role of autonomous robots and intelligent systems in industrial production which reflects their maturity and robustness The contributions have been selected through a rigorous peer review process and contain many exciting and visionary ideas that will further galvanize the research community spurring novel research directions The series of biennial IAS conferences commenced in 1986 and represents a premiere event in robotics **Feature Interactions in Telecommunications Systems** L. G. Bouma,H. Velthuijsen,1994 Features are modifications to the control of telecommunications services A feature interaction occurs when the behaviour of another which can lead to unexpected or undesired behaviour which affects the quality of service The goal of this volume is to generate a combination of techniques through protocol engineering software testing formal techniques and AI and applications to telecommunications services **Requirements Engineering: Foundation for Software Quality** Anne Hess,Angelo Susi,2025-05-02 This book constitutes the refereed proceedings of the 31st International Working Conference on Requirements Engineering Foundation for Software Quality REFSQ 2025 held in Barcelona Spain during April 7 10 2025 The 21 full papers and 8 short papers included in this book were carefully reviewed and selected from 74 submissions They were organized in topical sections as follows Responsible RE Crowd and Large Scale RE Requirements Modeling Requirements Elicitation and Analysis Participatory RE RE for Safety critical and Autonomous Systems and Requirements Quality Assurance Children's Influence on Family Dynamics Ann C. Crouter,Alan Booth,2003-04-02 This volume addresses how children s personal qualities make their mark on families in ways that may in turn influence children s subsequent development **Formal Methods for Open Object-Based Distributed Systems V** Bart Jacobs,Arend Rensink,2013-04-17 Formal Methods for Open Object Based Distributed Systems V brings together research in three important and related fields Formal methods

Distributed systems Object based technology Such a convergence is representative of recent advances in the field of distributed systems and provides links between several scientific and technological communities The wide scope of topics covered in this volume range in subject from UML to object based languages and calculi and security and in approach from specification to case studies and verification This volume comprises the proceedings of the Fifth International Conference on Formal Methods for Open Object Based Distributed Systems FMOODS 2002 which was sponsored by the International Federation for Information Processing IFIP and held in Enschede The Netherlands in March 2002

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