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Tomás E. Uribe, Abstraction-based Deductive-Algorithmic Verification of Reactive Systems, PhD Thesis, Computer Science Department, Stanford University, December 1998. Abstract. Michael A. Colón and Tomás E. Uribe. Generating Finite-State Abstractions of Reactive Systems Using Decision Procedures.

CS357: Formal verification of reactive systems. Topics covered

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This book is a solid foundation of the most important formalisms used for specification and verification of reactive systems. In particular, the text presents all important results on m-calculus, w-automata, and temporal logics, shows the relationships between these formalisms and describes state-of-the-art verification procedures for them. It also discusses advantages and disadvantages of these formalisms, and shows up their strengths and weaknesses. Most results are given with detailed proofs, so that the presentation is almost self-contained. Includes all definitions without relying on other material Proves all theorems in detail Presents detailed algorithms in pseudo-code for verification as well as translations to other formalisms

Formal methods is the term used to describe the specification and verification of software and software systems using mathematical logic. Various methodologies have been developed and incorporated into software tools. An important subclass is distributed systems. There are many books that look at particular methodologies for such systems, e.g. CSP, process algebra. This book offers a more balanced introduction for graduate students that describes the various approaches, their strengths and weaknesses, and when they are best used. Milner's CCS and its operational semantics are introduced, together with notions of behavioural equivalence based on bisimulation techniques and with variants of Hennessy-Milner modal logics. Later in the book, the presented theories are extended to take timing issues into account. The book has arisen from various courses taught in Iceland and Denmark and is designed to give students a broad introduction to the area, with exercises throughout.

This book is about the verification of reactive systems. A reactive system is a system that maintains an ongoing interaction with its environment, as opposed to computing some final value on termination. The family of reactive systems includes many classes of programs whose correct and reliable construction is con sidered to be particularly challenging, including concurrent programs, embedded and process control programs, and operating systems. Typical examples of such systems are an air traffic control system, programs controlling mechanical devices such as a train, or perpetually ongoing processes such as a nuclear reactor. With the expanding use of computers in safety-critical areas, where failure is potentially disastrous, correctness is crucial. This has led to the introduction of formal verification techniques, which give both users and designers of software and hardware systems greater confidence that the systems they build meet the desired specifications. Framework The approach promoted in this book is based on the use of temporal logic for specifying properties of reactive systems, and develops an extensive verification methodology for proving that a system meets its temporal specification. Reactive programs must be specified in terms of their ongoing behavior, and temporal logic provides an expressive and natural language for specifying this behavior. Our framework for specifying and verifying temporal properties of reactive systems is based on the following four components: 1. A computational model to describe the behavior of reactive systems. The model adopted in this book is that of a Fair Transition System (FTS).

Testing is the primary hardware and software verification technique used by industry today. Usually, it is ad hoc, error prone, and very expensive. In recent years, however, many attempts have been made to develop more sophisticated formal testing methods. This coherent book provides an in-depth assessment of this emerging field, focusing on formal testing of reactive systems. This book is based on a seminar held in Dagstuhl Castle, Germany, in January 2004. It presents 19 carefully reviewed and revised lectures given at the seminar in a well-balanced way ensuring competent complementary coverage of all relevant aspects. An appendix provides a glossary for model-based testing and basics on finite state machines and on labelled transition systems. The lectures are presented in topical sections on testing of finite state machines, testing of labelled transition systems, model-based test case generation, tools and case studies, standardized test notation and execution architectures, and beyond testing.

In-spite of three decades of software formal verification and validation (FV & V) research, there exists no ideal FV & V technique that works well for all FV & V concerns. That is, there is no one technique that enables (i) easy and correct construction of requirement specification of complex real-life properties, and (ii) complete verification coverage of complete real-life complex software with respect to those requirements. Moreover, many of the FV

& V techniques are ineffective in handling temporal behavior of reactive systems. In this paper we use a cuboid to characterize the trade space among three categories of FV & V techniques. We illustrate the use of the cuboid in tradeoff analysis to determine the appropriate techniques for V & V based on cost and coverage.

This book is based upon work done under the project "Correct Software through Formal Methods" supported by the German Ministry of Research and Technology. As a case-study report on the practice of formal software development, this book systematically presents and compares 18 different approaches to the control of a real-world production cell. Mathematically precise, formal methods play an increasingly important role in software development, particularly in areas where failure of software would result in injury to people or, at best, significant loss of money. By analyzing the benefits and explaining the use and limitations of formal methods on a sample basis, this book provides a roadmap for the selection and application of appropriate approaches and thus helps in putting formal methods into industrial use.

Model checking is a powerful approach for the formal verification of software. It automatically provides complete proofs of correctness, or explains, via counter-examples, why a system is not correct. Here, the author provides a well written and basic introduction to the new technique. The first part describes in simple terms the theoretical basis of model checking: transition systems as a formal model of systems, temporal logic as a formal language for behavioral properties, and model-checking algorithms. The second part explains how to write rich and structured temporal logic specifications in practice, while the third part surveys some of the major model checkers available.

This title is devoted to presenting some of the most importantconcepts and techniques for describing real-time systems andanalyzing their behavior in order to enable the designer to achieveguarantees of temporal correctness. Topics addressed include mathematical models of real-timesystems and associated formal verification techniques such as modelchecking, probabilistic modeling and verification, programming anddescription languages, and validation approaches based on testing.With contributions from authors who are experts in their respectivefields, this will provide the reader with the state of the art informal verification of real-time systems and an overview ofavailable software tools.