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Principles of Model Checking offers a comprehensive introduction to model checking that is not only a text suitable for classroom use but also a valuable reference for researchers and practitioners in the field.The book begins with the basic principles for modeling concurrent and communicating systems, introduces different classes of properties (including safety and liveness), presents the notion of fairness, and provides automata-based algorithms for these properties.

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167, 157 389, 369]. Alternative LTL model-checking algorithms that do not use Büchi automata, but a so-called tableau for the LTL formula, were presented by Lichtenstein and Pnueli [273] and Clarke, Grumberg, and Hamaguchi [88]. The results about the complexity of LTL model checking and the satisfiability problem are due to Sistla and Clarke ...

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computer-based control systems is that of model checking. Model checking is a formal verification technique which allows for desired behavioral properties of a given system to be verified on the basis of a suitable model of the system through systematic inspection of all states of the model. The attractiveness of model checking comes from the fact that

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Model checking is an established technique for automatically verifying that a model (Labelled Transition System, LTS), obtained from higherlevel specification languages such as process algebra,...

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Subtle errors, for instance due to multi-threading, that remain undiscovered using simulation or peer reviewing can potentially be revealed using model checking. Model checking is thus an effective technique to expose potential design errors and improve software and hardware reliability.

Introduction to Model Checking | Informatik 2

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Model Checking I Exercises on Models and Modelling with (some) Solutions Teacher: Luca Tesei Master of Science in Computer Science - University of Camerino Contents 1 Transition systems and Program Graphs 2 2 Channel Systems and nano Promela 11 1

Model Checking I Exercises on Models and Modelling with ...

Model checking is based on, well, checking models. So, we first start by explaining what models are, and will make clear that so-called labeled transition systems, a model that is akin to automata, are suitable for modeling sequential, as well as multi-threading programs.

Introduction to Model Checking | Informatik 2

Principles of Model Checking offers a comprehensive introduction to model checking that is not only a text suitable for classroom use but also a valuable reference for researchers and practitioners in the field.

Principles of Model Checking (The MIT Press) ...

15-817 Textbooks: C: Model Checking by Edmund M. Clarke, Orna Grumberg, and Doron Peled. (1999, MIT Press). B: Principles of Model Checking by Christel Baier and Joost-Pieter Katoen. (2008, MIT Press).

A comprehensive introduction to the foundations of model checking, a fully automated technique for finding flaws in hardware and software; with extensive examples and both practical and theoretical exercises. Our growing dependence on increasingly complex computer and software systems necessitates the development of formalisms, techniques, and tools for assessing functional properties of these systems. One such technique that has emerged in the last twenty years is model checking, which systematically (and automatically) checks whether a model of a given system satisfies a desired property such as deadlock freedom, invariants, and request-response properties. This automated technique for verification and debugging has developed into a mature and widely used approach with many applications. Principles of Model Checking offers a comprehensive introduction to model checking that is not only a text suitable for classroom use but also a valuable reference for researchers and practitioners in the field. The book begins with the basic principles for modeling concurrent and communicating systems, introduces different classes of properties (including safety and liveness), presents the notion of fairness, and provides automata-based algorithms for these properties. It introduces the temporal logics LTL and CTL, compares them, and covers algorithms for verifying these logics, discussing real-time systems as well as systems subject to random phenomena. Separate chapters treat such efficiency-improving techniques as abstraction and symbolic manipulation. The book includes an extensive set of examples (most of which run through several chapters) and a complete set of basic results accompanied by detailed proofs. Each chapter concludes with a summary, bibliographic notes, and an extensive list of exercises of both practical and theoretical nature.

Emphasizing concepts and rationale over mathematical minutiae, this is the most widely used, complete, and accessible structural equation modeling (SEM) text. Continuing the tradition of using real data examples from a variety of disciplines, the significantly revised fourth edition incorporates recent developments such as Pearl's graphing theory and the structural causal model (SCM), measurement invariance, and more. Readers gain a comprehensive understanding of all phases of SEM, from data collection and screening to the interpretation and reporting of the results. Learning is enhanced by exercises with answers, rules to remember, and topic boxes. The companion website supplies data, syntax, and output for the book's examples--now including files for Amos, EQS, LISREL, Mplus, Stata, and R (lavaan). New to This Edition *Extensively revised to cover important new topics: Pearl's graphing theory and the SCM, causal inference frameworks, conditional process modeling, path models for longitudinal data, item response theory, and more. *Chapters on best practices in all stages of SEM, measurement invariance in confirmatory factor analysis, and significance testing issues and bootstrapping. *Expanded coverage of psychometrics. *Additional computer tools: online files for all detailed examples, previously provided in EQS, LISREL, and Mplus, are now also given in Amos, Stata, and R (lavaan). *Reorganized to cover the specification, identification, and analysis of observed variable models separately from latent variable models. Pedagogical Features *Exercises with answers, plus end-of-chapter annotated lists of further reading. *Real examples of troublesome data, demonstrating how to handle typical problems in analyses. *Topic boxes on specialized issues, such as causes of nonpositive definite correlations. *Boxed rules to remember. *Website promoting a learn-by-doing approach, including syntax and data files for six widely used SEM computer tools.

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.

Our growing dependence on increasingly complex computer and software systemsnecessitates the development of formalisms, techniques, and tools for assessing functionalproperties of these systems. One such technique that has emerged in the last twenty years is modelchecking, which systematically (and automatically) checks whether a model of a given systemsatisfies a desired property such as deadlock freedom, invariants, and request-response properties.This automated technique for verification and debugging has developed into a mature and widely usedapproach with many applications. Principles of Model Checking offers a comprehensive introduction tomodel checking that is not only a text suitable for classroom use but also a valuable reference forresearchers and practitioners in the field. The book begins with the basic principles for modelingconcurrent and communicating systems, introduces different classes of properties (including safetyand liveness), presents the notion of fairness, and provides automata-based algorithms for theseproperties. It introduces the temporal logics LTL and CTL, compares them, and covers algorithms forverifying these logics, discussing real-time systems as well as systems subject to random phenomena.Separate chapters treat such efficiency-improving techniques as abstraction and symbolicanipulation. The book includes an extensive set of examples (most of which run through severalchapters) and a complete set of basic results accompanied by detailed proofs. Each chapter concludeswith a summary, bibliographic notes, and an extensive list of exercises of both practical andtheoretical nature.Christel Baier is Professor and Chair for Algebraic and Logical Foundations ofComputer Science in the Faculty of Computer Science at the Technical University of Dresden.Joost-Pieter Katoen is Professor at the RWTH Aachen University and leads the Software Modeling andVerification Group within the Department of Computer Science. He is affiliated with the FormalMethods and Tools Group at the University of Twente.

An expanded and updated edition of a comprehensive presentation of the theory and practice of model checking, a technology that automates the analysis of complex systems. Model checking is a verification technology that provides an algorithmic means of determining whether an abstract modelrepresenting, for example, a hardware or software design,satisfies a formal specification expressed as a temporal logic formula. If the specification is not satisfied, the method identifies a counterexample execution that shows the source of the problem. Today, many major hardware and software companies use model checking in practice, for verification of VLSI circuits, communication protocols, software device drivers, real-time embedded systems, and security algorithms. This book offers a comprehensive presentation of the theory and practice of model checking, covering the foundations of the key algorithms in depth. The field of model checking has grown dramatically since the publication of the first edition in 1999, and this second edition reflects the advances in the field. Reorganized, expanded, and updated, the new edition retains the focus on the foundations of temporal logic model while offering new chapters that cover topics that did not exist in 1999: propositional satisfiability, SAT-based model checking, counterexample-guided abstraction refinement, and software model checking. The book serves as an introduction to the field suitable for classroom use and as an essential guide for researchers.

Advances in computing hardware and algorithms have dramatically improved the ability to simulate complex processes computationally. Today's simulation capabilities offer the prospect of addressing questions that in the past could be addressed only by resource-intensive experimentation, if at all. Assessing the Reliability of Complex Models recognizes the ubiquity of uncertainty in computational estimates of reality and the necessity for its quantification. As computational science and engineering have matured, the process of quantifying or bounding uncertainties in a computational estimate of a physical quality of interest has evolved into a small set of interdependent tasks: verification, validation, and uncertainty of quantification (VUUQ). In recognition of the increasing importance of computational simulation and the increasing need to assess uncertainties in computational results, the National Research Council was asked to study the mathematical foundations of VUUQ and to recommend steps that will ultimately lead to improved processes. Assessing the Reliability of Complex Models discusses changes in education of professionals and dissemination of information that should enhance the ability of future VUUQ practitioners to improve and properly apply VUUQ methodologies to difficult problems, enhance the ability of VUUQ customers to understand VUUQ results and use them to make informed decisions, and enhance the ability of all VUUQ stakeholders to communicate with each other. This report is an essential resource for all decision and policy makers in the field, students, stakeholders, UQ experts, and VUUQ educators and practitioners.

Now in its third edition, this classic book is widely considered the leading text on Bayesian methods, lauded for its accessible, practical approach to analyzing data and solving research problems. Bayesian Data Analysis, Third Edition continues to take an applied approach to analysis using up-to-date Bayesian methods. The authors'all leaders in the statistics community/introduce basic concepts from a data-analytic perspective before presenting advanced methods. Throughout the text, numerous worked examples drawn from real applications and research emphasize the use of Bayesian inference in practice. New to the Third Edition Four new chapters on nonparametric modeling Coverage of weakly informative priors and boundary-avoiding priors Updated discussion of cross-validation and predictive information criteria Improved convergence monitoring and effective sample size calculations for iterative simulation Presentations of Hamiltonian Monte Carlo, variational Bayes, and expectation propagation New and revised software code The book can be used in three different ways. For undergraduate students, it introduces Bayesian inference starting from first principles. For graduate students, the text presents effective current approaches to Bayesian modeling and computation in statistics and related fields. For researchers, it provides an assortment of Bayesian methods in applied statistics. Additional materials, including data sets used in the examples, solutions to selected exercises, and software instructions, are available on the book's web page.

This book constitutes the refereed proceedings of the 15th International SPIN workshop on Model Checking Software, SPIN 2008, held in Los Angeles, CA, USA, in August 2008. The 17 revised full papers presented together with 1 tool paper and 4 invited talks were carefully reviewed and selected from 41 submissions. The main focus of the workshop series is software systems, including models and programs. The papers cover theoretical and algorithmic foundations as well as tools for software model checking and foster interactions and exchanges of ideas with related areas in software engineering, such as static analysis, dynamic analysis, and testing.

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RISA-3D (Rapid Interactive Structural Analysis) is used for structural analysis and design. The tools in RISA-3D are primarily used in structural engineering and they help users to design structural models using both parametric 3D modeling and 2D drafting elements. The RISA-3D model comprise of a physical representation of a structure. The structural modeling in RISA-3D can be used for structural designing and analysis application. The Exploring RISA-3D 14.0 book explains the concepts and principles of RISA-3D through practical examples, tutorials, and exercises. This enables the users to harness the power of structural designing with RISA-3D for their specific use. In this book, the author emphasizes on physical modeling, structural desining, creating load cases, specifying boundary conditions, preparation of project report. This book covers the various stages involved in analyzing. This book is specially meant for professionals and students in structural engineering, civil engineering, and allied fields in the building industry. Salient Features Detailed explanation of RISA-3D Real-world projects given as tutorials Tips and Notes throughout the textbook 200 pages of heavily illustrated text Self-Evaluation Tests, Review Questions, and Exercises at the end of the chapters Table of Contents Chapter 1: Introduction to RISA-3D Chapter 2: Getting Start with RISA-3D Chapter 3: Modeling Chapter 4: Loads Chapter 5: Boundary Conditions Chapter 6: Performing Analysis and Specifying Design Parameters Chapter 7: Viewing Results and Preparing Report Index