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A collection of papers that address such issues as model limits and reliability, emerging expert systems and integrated gas and solid phase combustion simulation models. In this remarkable blend of formal theory and practical application, David Heckerman develops methods for building normative expert systems—expert systems that encode knowledge in a decision-theoretic framework. Heckerman introduces the similarity network and partition, two extensions to the influence diagram representation. He uses the new representations to construct Pathfinder, a large, normative expert system for the diagnosis of lymph-node diseases. Heckerman shows that such expert systems can be built efficiently, and that the use of a normative theory as the framework for representing knowledge can dramatically improve the quality of expertise that is delivered to the user. He concludes with a formal evaluation of the power of his methods for building normative expert systems. David Heckerman is Assistant Professor of Computer Science at the University of Southern California. He received his doctoral degree in Medical Information Sciences from Stanford University. Contents: Introduction. Similarity Networks and Partitions: A Simple Example. Theory of Similarity

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Networks. Pathfinder: A Case Study. An Evaluation of Pathfinder. Conclusions and Future Work.

The work reviewed in this book represents the synthesis of two important developments in modelling of complex stochastic phenomena. The book gives a thorough and rigorous mathematical treatment of the underlying ideas, structures, and algorithms. The proceedings of the Second International Conference on [title] held in Cambridge, Massachusetts, April 1991, comprise 55 papers on topics including the logical specifications of reasoning behaviors and representation formalisms, comparative analysis of competing algorithms and formalisms, and ana

Probabilistic Methods for Financial and Marketing Informatics aims to provide students with insights and a guide explaining how to apply probabilistic reasoning to business problems. Rather than dwelling on rigor, algorithms, and proofs of theorems, the authors concentrate on showing examples and using the software package Netica to represent and solve problems. The book contains unique coverage of probabilistic reasoning topics applied to business problems, including marketing, banking, operations management, and finance. It shares insights about when and why probabilistic methods can and cannot be used effectively. This book is recommended for all R&D professionals and students who are involved with industrial informatics, that is, applying the methodologies of computer science and engineering to business or industry information. This includes computer science and other professionals in the

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data management and data mining field whose interests are business and marketing information in general, and who want to apply AI and probabilistic methods to their problems in order to better predict how well a product or service will do in a particular market, for instance. Typical fields where this technology is used are in advertising, venture capital decision making, operational risk measurement in any industry, credit scoring, and investment science. Unique coverage of probabilistic reasoning topics applied to business problems, including marketing, banking, operations management, and finance Shares insights about when and why probabilistic methods can and cannot be used effectively Complete review of Bayesian networks and probabilistic methods for those IT professionals new to informatics.

This text is a reprint of the seminal 1989 book Probabilistic Reasoning in Expert systems: Theory and Algorithms, which helped serve to create the field we now call Bayesian networks. It introduces the properties of Bayesian networks (called causal networks in the text), discusses algorithms for doing inference in Bayesian networks, covers abductive inference, and provides an introduction to decision analysis. Furthermore, it compares rule-base experts systems to ones based on Bayesian networks, and it introduces the frequentist and Bayesian approaches to probability. Finally, it provides a critique of the maximum entropy formalism. Probabilistic Reasoning in Expert Systems was written from the perspective of a mathematician with the emphasis being on the development of theorems and algorithms. Every effort was

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made to make the material accessible. There are ample examples throughout the text.

This text is important reading for anyone interested in both the fundamentals of Bayesian networks and in the history of how they came to be. It also provides an insightful comparison of the two most prominent approaches to probability.

Uncertain Information Processing in Expert Systems systematically and critically examines probabilistic and rule-based (compositional, MYCIN-like) systems, the two most important families of expert systems dealing with uncertainty. The book features a detailed introduction to probabilistic systems (including methods using graphical models and methods of knowledge integration), an analysis of compositional systems based on algebraic considerations, an application of graphical models, and the Dempster-Shafer theory of evidence and its use in expert systems. The book will be useful to anyone working in artificial intelligence, statistical computing, symbolic logic, and expert systems.

Bayesian Networks and Influence Diagrams: A Guide to Construction and Analysis, Second Edition, provides a comprehensive guide for practitioners who wish to understand, construct, and analyze intelligent systems for decision support based on probabilistic networks. This new edition contains six new sections, in addition to fully-updated examples, tables, figures, and a revised appendix. Intended primarily for practitioners, this book does not require sophisticated mathematical skills or deep understanding of the underlying theory and methods nor does it discuss alternative

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technologies for reasoning under uncertainty. The theory and methods presented are illustrated through more than 140 examples, and exercises are included for the reader to check his or her level of understanding. The techniques and methods presented for knowledge elicitation, model construction and verification, modeling techniques and tricks, learning models from data, and analyses of models have all been developed and refined on the basis of numerous courses that the authors have held for practitioners worldwide.

By presenting state-of-the-art results in logical reasoning and formal methods in the context of artificial intelligence and AI applications, this book commemorates the 60th birthday of Jörg H. Siekmann. The 30 revised reviewed papers are written by former and current students and colleagues of Jörg Siekmann; also included is an appraisal of the scientific career of Jörg Siekmann entitled "A Portrait of a Scientist: Logics, AI, and Politics." The papers are organized in four parts on logic and deduction, applications of logic, formal methods and security, and agents and planning.

Probabilistic Expert Systems emphasizes the basic computational principles that make probabilistic reasoning feasible in expert systems. The key to computation in these systems is the modularity of the probabilistic model. Shafer describes and compares the principal architectures for exploiting this modularity in the

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computation of prior and posterior probabilities. He also indicates how these similar yet different architectures apply to a wide variety of other problems of recursive computation in applied mathematics and operations research. The field of probabilistic expert systems has continued to flourish since the author delivered his lectures on the topic in June 1992, but the understanding of join-tree architectures has remained missing from the literature. This monograph fills this void by providing an analysis of join-tree methods for the computation of prior and posterior probabilities in belief nets. These methods, pioneered in the mid to late 1980s, continue to be central to the theory and practice of probabilistic expert systems. In addition to purely probabilistic expert systems, join-tree methods are also used in expert systems based on Dempster-Shafer belief functions or on possibility measures. Variations are also used for computation in relational databases, in linear optimization, and in constraint satisfaction. This book describes probabilistic expert systems in a more rigorous and focused way than existing literature, and provides an annotated bibliography that includes pointers to conferences and software. Also included are exercises that will help the reader begin to explore the problem of generalizing from probability to broader domains of recursive computation.

As the power of Bayesian techniques has become more fully realized, the field of

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Artificial intelligence has embraced Bayesian methodology and integrated it to the point where an introduction to Bayesian techniques is now a core course in many computer science programs. Unlike other books on the subject, Bayesian Artificial Intelligence keeps mathematical detail to a minimum and covers a broad range of topics. The authors integrate all of Bayesian net technology and learning Bayesian net technology and apply them both to knowledge engineering. They emphasize understanding and intuition but also provide the algorithms and technical background needed for applications. Software, exercises, and solutions are available on the authors' website.

In a systematic and clear manner, the authors discuss the problems associated with clinical decision making and explore the current methods to solve them. In this monograph, they examine the results of combining the classical control system approach with the symbolic approaches which have been central to developments in artificial intelligence. Well illustrated with case studies, this volume will prove to be an invaluable resource to system scientists, engineers, computer scientists, and members of the medical community.

The leading resource in the statistical evaluation and interpretation of forensic evidence The third edition of *Statistics and the Evaluation of Evidence for Forensic Scientists* is fully updated to provide the latest research and

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developments in the use of statistical techniques to evaluate and interpret evidence. Courts are increasingly aware of the importance of proper evidence assessment when there is an element of uncertainty. Because of the increasing availability of data, the role of statistical and probabilistic reasoning is gaining a higher profile in criminal cases. That's why lawyers, forensic scientists, graduate students, and researchers will find this book an essential resource, one which explores how forensic evidence can be evaluated and interpreted statistically. It's written as an accessible source of information for all those with an interest in the evaluation and interpretation of forensic scientific evidence. Discusses the entire chain of reasoning—from evidence pre-assessment to court presentation; Includes material for the understanding of evidence interpretation for single and multiple trace evidence; Provides real examples and data for improved understanding. Since the first edition of this book was published in 1995, this respected series has remained a leading resource in the statistical evaluation of forensic evidence. It shares knowledge from authors in the fields of statistics and forensic science who are international experts in the area of evidence evaluation and interpretation. This book helps people to deal with uncertainty related to scientific evidence and propositions. It introduces a method of reasoning that shows how to update beliefs coherently and to act rationally. In this edition,

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readers can find new information on the topics of elicitation, subjective probabilities, decision analysis, and cognitive bias, all discussed in a Bayesian framework.

This volume aims to provide a collection of unique perspectives on the issues surrounding the management of information technology in organizations around the world and the ways in which these issues are addressed.

This is a brand new edition of an essential work on Bayesian networks and decision graphs. It is an introduction to probabilistic graphical models including Bayesian networks and influence diagrams. The reader is guided through the two types of frameworks with examples and exercises, which also give instruction on how to build these models. Structured in two parts, the first section focuses on probabilistic graphical models, while the second part deals with decision graphs, and in addition to the frameworks described in the previous edition, it also introduces Markov decision process and partially ordered decision problems.

The analysis of experimental data resulting from some underlying random process is a fundamental part of most scientific research. Probability Theory and Statistics have been developed as flexible tools for this analysis, and have been applied successfully in various fields such as Biology, Economics, Engineering, Medicine or Psychology. However, traditional techniques in Probability and

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Statistics were devised to model only a single source of uncertainty, namely randomness. In many real-life problems randomness arises in conjunction with other sources, making the development of additional "softening" approaches essential. This book is a collection of papers presented at the 2nd International Conference on Soft Methods in Probability and Statistics (SMPS'2004) held in Oviedo, providing a comprehensive overview of the innovative new research taking place within this emerging field.

A comprehensive overview of techniques and systems currently utilized in predictive toxicology, this reference presents an in-depth survey of strategies to characterize chemical structures and biological systems—covering prediction methods and algorithms, sources of high-quality toxicity data, the most important commercial and noncommercial predictive toxicology programs, and advanced technologies in computational chemistry and biology, statistics, and data mining. This book constitutes the refereed proceedings of the 22 International Conference on Database and Expert Systems Applications, DEXA 2011, held in Toulouse, France, August 29 - September 2, 2011. The 52 revised full papers and 40 short papers presented were carefully reviewed and selected from 207 submissions. The papers are organized in topical sections on query processing; database semantics; skyline queries; security and privacy; spatial and temporal

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data, semantic web search; storage and search; web search; data integration, transactions and optimization; and web applications.

The aim of this volume is to present to researchers and engineers working on problems concerned with the mechanics of solids and structures, the current state of the development and application to procedures for assessing the reliability of a system. Particular attention is paid to their use in the analysis of complex engineering systems. The topics covered reflect the need to integrate, within the overall methodology, statistical methods for dealing with uncertain parameters and random excitation with the development of a suitable safety indexes and design codes. The basic principles of reliability theory, together with current standard methodology, including a consideration of the operational, economic and legal aspects of reliability assurance, is reviewed, together with an introduction to new developments, such as the application of expert systems technology. Damage accumulation predictions, with applications in seismic engineering are also covered.

The increasing complexity of our world demands new perspectives on the role of technology in decision making. Human decision making has its limitations in terms of information-processing capacity. We need new technology to cope with the increasingly complex and information-rich nature of our modern society. This is

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particularly true for critical environments such as crisis management and traffic management, where humans need to engage in close collaborations with artificial systems to observe and understand the situation and respond in a sensible way. We believe that close collaborations between humans and artificial systems will become essential and that the importance of research into Interactive Collaborative Information Systems (ICIS) is self-evident.

Developments in information and communication technology have radically changed our working environments. The vast amount of information available nowadays and the wirelessly networked nature of our modern society open up new opportunities to handle difficult decision-making situations such as computer-supported situation assessment and distributed decision making. To make good use of these new possibilities, we need to update our traditional views on the role and capabilities of information systems. The aim of the Interactive Collaborative Information Systems project is to develop techniques that support humans in complex information environments and that facilitate distributed decision-making capabilities. ICIS emphasizes the importance of building actor-agent communities: close collaborations between human and artificial actors that highlight their complementary capabilities, and in which task distribution is flexible and adaptive.

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The Bayesian network is one of the most important architectures for representing and reasoning with multivariate probability distributions. When used in conjunction with specialized informatics, possibilities of real-world applications are achieved. Probabilistic Methods for Bioinformatics explains the application of probability and statistics, in particular Bayesian networks, to genetics. This book provides background material on probability, statistics, and genetics, and then moves on to discuss Bayesian networks and applications to bioinformatics. Rather than getting bogged down in proofs and algorithms, probabilistic methods used for biological information and Bayesian networks are explained in an accessible way using applications and case studies. The many useful applications of Bayesian networks that have been developed in the past 10 years are discussed. Forming a review of all the significant work in the field that will arguably become the most prevalent method in biological data analysis. Unique coverage of probabilistic reasoning methods applied to bioinformatics data--those methods that are likely to become the standard analysis tools for bioinformatics. Shares insights about when and why probabilistic methods can and cannot be used effectively; Complete review of Bayesian networks and probabilistic methods with a practical approach.

In the past decade, a number of different research communities within the

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computational sciences have studied learning in networks, starting from a number of different points of view. There has been substantial progress in these different communities and surprising convergence has developed between the formalisms. The awareness of this convergence and the growing interest of researchers in understanding the essential unity of the subject underlies the current volume. Two research communities which have used graphical or network formalisms to particular advantage are the belief network community and the neural network community. Belief networks arose within computer science and statistics and were developed with an emphasis on prior knowledge and exact probabilistic calculations. Neural networks arose within electrical engineering, physics and neuroscience and have emphasised pattern recognition and systems modelling problems. This volume draws together researchers from these two communities and presents both kinds of networks as instances of a general unified graphical formalism. The book focuses on probabilistic methods for learning and inference in graphical models, algorithm analysis and design, theory and applications. Exact methods, sampling methods and variational methods are discussed in detail. Audience: A wide cross-section of computationally oriented researchers, including computer scientists, statisticians, electrical engineers, physicists and neuroscientists.

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There are more than one billion documents on the Web, with the count continually rising at a pace of over one million new documents per day. As information increases, the motivation and interest in data warehousing and mining research and practice remains high in organizational interest. The Encyclopedia of Data Warehousing and Mining, Second Edition, offers thorough exposure to the issues of importance in the rapidly changing field of data warehousing and mining. This essential reference source informs decision makers, problem solvers, and data mining specialists in business, academia, government, and other settings with over 300 entries on theories, methodologies, functionalities, and applications.

Probabilistic Networks and Expert Systems Exact Computational Methods for Bayesian Networks Springer Science & Business Media

This book constitutes the refereed proceedings of the 6th International Conference on Rough Sets and Knowledge Technology, RSKT 2011, held in Banff, Canada, in September 2011. The 89 revised full papers presented together with 3 keynote lectures and 1 invited tutorial session were carefully reviewed and selected from 229 submissions. The papers are organized in topical sections on attribute reduction and feature selection, generalized rough set models, machine learning with rough and hybrid techniques, knowledge

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technology and intelligent systems and applications.

Probabilistic expert systems are graphical networks which support the modeling of uncertainty and decisions in large complex domains, while retaining ease of calculation. Building on original research by the authors, this book gives a thorough and rigorous mathematical treatment of the underlying ideas, structures, and algorithms. The book will be of interest to researchers in both artificial intelligence and statistics, who desire an introduction to this fascinating and rapidly developing field. The book, winner of the DeGroot Prize 2002, the only book prize in the field of statistics, is new in paperback.

This six-volume set presents cutting-edge advances and applications of expert systems. Because expert systems combine the expertise of engineers, computer scientists, and computer programmers, each group will benefit from buying this important reference work. An "expert system" is a knowledge-based computer system that emulates the decision-making ability of a human expert. The primary role of the expert system is to perform appropriate functions under the close supervision of the human, whose work is supported by that expert system. In the reverse, this same expert system can monitor and double check the human in the performance of a task. Human-computer interaction in our highly complex world requires the development of a wide array of expert systems. Key Features *

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Expert systems techniques and applications are presented for a diverse array of topics including:

- * Experimental design and decision support
- * The integration of machine learning with knowledge acquisition for the design of expert systems
- * Process planning in design and manufacturing systems and process control applications
- * Knowledge discovery in large-scale knowledge bases
- * Robotic systems
- * Geographic information systems
- * Image analysis, recognition and interpretation
- * Cellular automata methods for pattern recognition
- * Real-time fault tolerant control systems
- * CAD-based vision systems in pattern matching processes
- * Financial systems
- * Agricultural applications
- * Medical diagnosis

Inspired by the Encyclopedia of Statistical Sciences, Second Edition (ESS2e), this volume presents a concise, well-rounded focus on the statistical concepts and applications that are essential for understanding gathered data in the study of business, finance, and management science. The book successfully upholds the goals of ESS2e by combining both previously-published and newly developed contributions written by over 100 leading academics, researchers, and practitioner in a comprehensive, approachable format. The result is a succinct reference that unveils modern, cutting-edge approaches to acquiring and analyzing data across diverse subject areas within these three disciplines, including risk management, mathematical finance, economics, supply chain

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management, derivative pricing, and resource allocation. In addition, techniques related to survey methodology, computational statistics, and operations research are discussed, where applicable. Topics of coverage include: Logistics Decision analysis Optimization Simulation Forecasting Mathematical modeling Data mining

Intelligent Decision Support Systems have the potential to transform human decision making by combining research in artificial intelligence, information technology, and systems engineering. The field of intelligent decision making is expanding rapidly due, in part, to advances in artificial intelligence and network-centric environments that can deliver the technology. Communication and coordination between dispersed systems can deliver just-in-time information, real-time processing, collaborative environments, and globally up-to-date information to a human decision maker. At the same time, artificial intelligence techniques have demonstrated that they have matured sufficiently to provide computational assistance to humans in practical applications. This book includes contributions from leading researchers in the field beginning with the foundations of human decision making and the complexity of the human cognitive system. Researchers contrast human and artificial intelligence, survey computational intelligence, present pragmatic systems, and discuss future trends. This book will be an

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Invaluable resource to anyone interested in the current state of knowledge and key research gaps in the rapidly developing field of intelligent decision support. Uncertainty in Artificial Intelligence contains the proceedings of the Ninth Conference on Uncertainty in Artificial Intelligence held at the Catholic University of America in Washington, DC, on July 9-11, 1993. The papers focus on methods of reasoning and decision making under uncertainty as applied to problems in artificial intelligence (AI) and cover topics ranging from knowledge acquisition and automated model construction to learning, planning, temporal reasoning, and machine vision. Comprised of 66 chapters, this book begins with a discussion on causality in Bayesian belief networks before turning to a decision theoretic account of conditional ought statements that rectifies glaring deficiencies in classical deontic logic and forms a sound basis for qualitative decision theory. Subsequent chapters explore trade-offs in constructing and evaluating temporal influence diagrams; normative engineering risk management systems; additive belief-network models; and sensitivity analysis for probability assessments in Bayesian networks. Automated model construction and learning as well as algorithms for inference and decision making are also considered. This monograph will be of interest to both students and practitioners in the fields of AI and computer science.

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Probabilistic Modelling in Bioinformatics and Medical Informatics has been written for researchers and students in statistics, machine learning, and the biological sciences. The first part of this book provides a self-contained introduction to the methodology of Bayesian networks. The following parts demonstrate how these methods are applied in bioinformatics and medical informatics. All three fields - the methodology of probabilistic modeling, bioinformatics, and medical informatics - are evolving very quickly. The text should therefore be seen as an introduction, offering both elementary tutorials as well as more advanced applications and case studies.

This is a resource book on clinical decision support systems for informatics specialists, a textbook for teachers or students in health informatics and a comprehensive introduction for clinicians. It has become obvious that, in addition to physicians, other health professionals have need of decision support. Therefore, the issues raised in this book apply to a broad range of clinicians. The book includes chapters written by internationally recognized experts on the design, evaluation and application of these systems, who examine the impact of computer-based diagnostic tools both from the practitioner's perspective and that of the patient.

Provides a single record of technologies and practices of the Semantic approach to the

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management, organization, interpretation, retrieval, and use of Web-based data.

Artificial intelligence and expert systems have seen a great deal of research in recent years, much of which has been devoted to methods for incorporating uncertainty into models. This book is devoted to providing a thorough and up-to-date survey of this field for researchers and students.

This volume constitutes the refereed proceedings of the Second International Workshop on Advanced Methodologies for Bayesian Networks, AMBN 2015, held in Yokohama, Japan, in November 2015. The 18 revised full papers and 6 invited abstracts presented were carefully reviewed and selected from numerous submissions. In the International Workshop on Advanced Methodologies for Bayesian Networks (AMBN), the researchers explore methodologies for enhancing the effectiveness of graphical models including modeling, reasoning, model selection, logic-probability relations, and causality. The exploration of methodologies is complemented discussions of practical considerations for applying graphical models in real world settings, covering concerns like scalability, incremental learning, parallelization, and so on.

In recent years it has become apparent that an important part of the theory of Artificial Intelligence is concerned with reasoning on the basis of uncertain, incomplete or inconsistent information. Classical logic and probability theory are only partially adequate for this, and a variety of other formalisms have been developed, some of the most important being fuzzy methods, possibility theory, belief function theory, non

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monotonic logics and modal logics. The aim of this workshop was to contribute to the elucidation of similarities and differences between the formalisms mentioned above. Support for addressing the on-going global changes needs solutions for new scientific problems which in turn require new concepts and tools. A key issue concerns a vast variety of irreducible uncertainties, including extreme events of high multidimensional consequences, e.g., the climate change. The dilemma is concerned with enormous costs versus massive uncertainties of extreme impacts. Traditional scientific approaches rely on real observations and experiments. Yet no sufficient observations exist for new problems, and "pure" experiments, and learning by doing may be expensive, dangerous, or impossible. In addition, the available historical observations are often contaminated by past actions, and policies. Thus, tools are presented for the explicit treatment of uncertainties using "synthetic" information composed of available "hard" data from historical observations, the results of possible experiments, and scientific facts, as well as "soft" data from experts' opinions, and scenarios.

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