# 2d Ising Model Simulation

**As the role of computer simulations began to increase in importance, we sensed a need for a "meeting place" for both experienced simulators and neophytes to discuss new techniques and results in an evironment which promotes extended discussion. As a consequence of these concerns, The Center for Simulational Physics established an annual workshop on Recent Developments in Computer Simulation Studies in Condensed-Matter Physics. This year's workshop was the fifth in this series and the interest which the scientific community has shown demonstrates quite clearly the useful purpose which the series has served. The workshop was held at the University of Georgia, February 17-21, 1992, and these proceedings form a record of the workshop which is published with the goal of timely dissemination of the papers to a wider audience. The proceedings are divided into four parts. The first part contains invited papers which deal with simulational studies of classical systems and includes an introduction to some new simulation techniques and special purpose computers as well. A separate section of the proceedings is devoted to invited papers on quantum systems including new results for strongly correlated electron and quan tum spin models. The third section is comprised of a single, invited description of a newly developed software shell designed for running parallel programs. The contributed presentations comprise the final chapter.**

**Markov Chain Monte Carlo (MCMC) originated in statistical physics, but has spilled over into various**

**application areas, leading to a corresponding variety of techniques and methods. That variety stimulates new ideas and developments from many different places, and there is much to be gained from cross-fertilization. This book presents five expository essays by leaders in the field, drawing from perspectives in physics, statistics and genetics, and showing how different aspects of MCMC come to the fore in different contexts. The essays derive from tutorial lectures at an interdisciplinary program at the Institute for Mathematical Sciences, Singapore, which exploited the exciting ways in which MCMC spreads across different disciplines.**

**Originally published in 1973, this is the definitive book on the Ising model, a mathematical model of ferromagnetism in statistical mechanics. This updated edition of the classic text features an extensive section on new developments.**

**Computer Simulation Studies in Condensed-Matter Physics IX covers recent developments in this field. This workshop was the ninth in this series and was held at the University of Georgia, March 4-9, 1996, and these proceedings form a record which is published with the goal of timely dissemination of the material to a wider audience. This volume is composed of three parts. The first section contains invited papers that deal with simulational studies of classical systems. The second section of the proceedings is devoted to invited papers on quantum systems, including new results for strongly correlated electron and quantum spin models. The final section comprises contributed presentations.**

**Computer Simulation Studies in Condensed-Matter Physics VIII**

**Temporal Aspects of Coding and Information Processing in Biological Systems**
**Computer Simulations of Surfaces and Interfaces**
**Phase Changes in the Ising Model**
**Proceedings of the Seventeenth Workshop, Athens, GA, USA, February 16-20, 2004**
**Liquid Crystals and Their Computer Simulations**
**Problem Solving with Python**

The aim of this thesis is to develop efficient transition matrix Monte Carlo simulation methods for complex systems(e.g., spin glasses) that enable one to construct the transition matrix from which the density of states is calculated with high accuracy. In this thesis, I explore a series of the transition matrix Monte Carlo techniques that are newly developed to generate the density of states with high accuracy for various systems that exhibit phase transitions. The Ising model and the Potts model are used to demonstrate the performance of each methods. Especially, the specific heat curve of the two-dimensional Ising model is evaluated and compared to the exact result as a stringent accuracy test in many cases. I extend the \emph{monovariate} multicanonical transition matrix Monte Carlo method to a \emph{bivariate} version for the calculation of the joint density of states which depends on the energy and a second variable associated with the order parameter. This bivariate version is applied to the Edward-Anderson spin glass model which is one of the most challenging model in the field of computer simulation. After presenting the theoretical basis of the transition matrix Monte Carlo method, I explain the regulated temperature method which populates the transition matrix by the Metropolis algorithm with continuously varying temperature according to a certain schedule. I introduce new techniques that can produce the optimized temperature schedule in the context of

the two-dimensional Ising model. Next I proceed to present the multicanonical transition matrix Monte Carlo method in which the transition matrix is constructed through the multicanonical iteration procedure. Although this method itself is faster than other existing techniques such as the broad histogram method and Wang-Landau algorithm, its simulation speed can be further increased by the renormalization idea which utilizes the simulation results for a small system to obtain an accurate initial estimate of the density of states for a large system through the convolution procedures. Especially a novel procedure about how to apply the renormalization idea in multiple dimensions is presented. To study the critical behavior of the spin glasses, to my knowledge for the first time, I employ the \emph{bivariate} multicanonical sampling to construct the transition tensor from which the joint density of states can be calculated with high accuracy. I introduce a calculation technique that transforms the massive transition tensor to a normal transition matrix to avoid the cumbersome manipulation of tensors. Using the joint density of states, Landau free energies, the probability distribution functions of spin overlap and Binder parameters are calculated. Contrary to the majority of the previous reports in the literature, the results of my method provide evidences that nonzero temperature phase transition occurs in the two-dimensional Ising spin glass. For the $\pm J$ Ising spin glass, the critical temperature obtained by my method is $T\underline{c}/J \approx 0.45$ However, a definite conclusion can not be made due to small systems sizes and the limitted number of samples of random couplings.

A simulation of phase transition for a two dimensional Ising lattice is performed on a Dell 450 computer. A computer program is developed using Turbo Pascal 6.0, to simulate a spin lattice in equilibrium with a heat bath. Metropolis algorithm was implemented which uses a simple Monte Carlo

sampling scheme and is briefed as follows : a lattice configuration of spins is generated and the initial energy of the system computed. Then, a random trial change in the initial configuration is made. If the change in energy AE of the system is negative or equal to zero, the new configuration is accepted. If AE is positive, the change is allowed with a transition probability. The physical quantities of interest, such as the mean energy, mean magnetization, specific heat capacity and the susceptibility are obtained and their variation with time, temperature and lattice size is studied. Difficulties arose when it was found out that the temperature dependence of the mean magnetization, specific heat and susceptibility of our simulated system is independent of the lattice size. The results obtained are compared to literature and discussed in this work. No attempt was done to determine the critical point exponents near the critical temperature or the study of the elimination of critical slowing down due to above difficulties.

This book series in the rapidly growing field of computational physics offers up-to-date (submitted to the publisher by electronic mail) reviews for the researcher. The first volume, written by authors from four continents, emphasizes statistical physics. For example, Ising problems are reviewed where theoretical approaches led to contradictory approaches and only quality computing answered who is right. In addition, fields as diverse as neural networks, granular materials, and computer algebra are reviewed. The next volume on percolation and other fields is already in preparation. Contents:Computational Aspects of Damage Spreading (N Jan & L de Arcangelis)Monte Carlo Simulations of Dilute Ising Models (W Selke et al.)Interfacial Dynamics in Disordered Magnets: Relaxation, Critical Dynamics, and Domain Growth (D Chowdhury & B Biswal)Ising System in Oscillating Field: Hysteretic Response (M Acharyya & B K Chakrabarti)Recent

Results on the Decay of Metastable Phases (P A Rikvold & B M Gorman)Multineuron Interaction Effects (R M C de Almeida et al.)Random and Self-Avoiding Walks in Disordered Media (H Nakanishi)Granular Dynamics: A Review About Recent Molecular Dynamics Simulations of Granular Materials (G H Ristow)Symbolic-Numeric Interfaces (M C Dewar)
Readership: Computational physicists, theoretical physicists and statistical physicists.
keywords:Nucleation;Interface;Damage Spreading;Neural Nets

LNCS volumes 2073 and 2074 contain the proceedings of the International Conference on Computational Science, ICCS 2001, held in San Francisco, California, May 27 -31, 2001. The two volumes consist of more than 230 contributed and invited papers that reflect the aims of the conference to bring together researchers and scientists from mathematics and computer science as basic computing disciplines, researchers from various application areas who are pioneering advanced application of computational methods to sciences such as physics, chemistry, life sciences, and engineering, arts and humanitarian fields, along with software developers and vendors, to discuss problems and solutions in the area, to identify new issues, and to shape future directions for research, as well as to help industrial users apply various advanced computational techniques.

Computer Simulation Studies in Condensed-Matter Physics IX

Simplicity Behind Complexity

Cellular Automata

Computational Science – ICCS 2001

Unphysical Frozen States in Monte Carlo Simulation of 2D Ising Model

International Conference, Glasgow, UK, May 8-11, 2006, Proceedings

Calculation of Interface Tension and Stiffness in a Two Dimensional Ising Model by Monte Carlo Simulation

**Computer Simulation Studies in Condensed-Matter Physics VIII covers recent developments in this field presented at the 1995 workshop, such as new algorithms, methods of analysis, and conceptual developments. This volume is composed of three parts. The first part contains invited papers that deal with simulational studies of classical systems. The second part is devoted to invited papers on quantum systems, including new results for strongly correlated electron and quantum spin models. The final part comprises contributed presentations.**

**This book describes the recent evolution of solid-state physics, which is primarily dedicated to examining the behavior of solids at the atomic scale. It also presents various state-of-the-art reviews and original contributions related to solid-state sciences. The book consists of four sections, namely, solid-state behavior, metastable materials, spintronics materials, and mechanics of deformable bodies. The authors' contributions relating to solid-state behavior deal with the performance of solid matters pertaining to quantum mechanics, physical metallurgy, and**

**crystallography. The authors' contributions relating to metastable materials demonstrate the behavior of amorphous/bulk metallic glasses and some nonequilibrium materials. The authors' contributions relating to spintronic materials explain the principles and equations underlying the physics, transport, and dynamics of spin in solid-state systems. The authors' contributions relating to the mechanics of deformable bodies deal with applications of numeric and analytic solutions/models for solid-state structures under deformation. Key Features:Issues in solid-state physics, Lagrangian quantum mechanics,Quantum and thermal behavior of HCP crystals,Thermoelectric properties of semiconductors,Bulk metallic glasses and metastable atomic density determination,Applications of spintronics and Heusler alloys, 2D elastostatic, mathematical modeling and dynamic stiffness methods on deformable bodies. This book provides an introduction to Monte Carlo simulations in classical statistical physics and is aimed both at students beginning work in the field and at more experienced researchers who wish to learn more about Monte Carlo methods. The material covered includes methods for**

**both equilibrium and out of equilibrium systems, and common algorithms like the Metropolis and heat-bath algorithms are discussed in detail, as well as more sophisticated ones such as continuous time Monte Carlo, cluster algorithms, multigrid methods, entropic sampling and simulated tempering. Data analysis techniques are also explained starting with straightforward measurement and error-estimation techniques and progressing to topics such as the single and multiple histogram methods and finite size scaling. The last few chapters of the book are devoted to implementation issues, including discussions of such topics as lattice representations, efficient implementation of data structures, multispin coding, parallelization of Monte Carlo algorithms, and random number generation. At the end of the book the authors give a number of example programmes demonstrating the applications of these techniques to a variety of well-known models.**

**The use of computation and simulation has become an essential part of the scientific process. Being able to transform a theory into an algorithm requires significant theoretical insight, detailed physical and mathematical understanding, and a working**

**level of competency in programming. This upper-division text provides an unusually broad survey of the topics of modern computational physics from a multidisciplinary, computational science point of view. Its philosophy is rooted in learning by doing (assisted by many model programs), with new scientific materials as well as with the Python programming language. Python has become very popular, particularly for physics education and large scientific projects. It is probably the easiest programming language to learn for beginners, yet is also used for mainstream scientific computing, and has packages for excellent graphics and even symbolic manipulations. The text is designed for an upper-level undergraduate or beginning graduate course and provides the reader with the essential knowledge to understand computational tools and mathematical methods well enough to be successful. As part of the teaching of using computers to solve scientific problems, the reader is encouraged to work through a sample problem stated at the beginning of each chapter or unit, which involves studying the text, writing, debugging and running programs, visualizing the results, and the expressing in words what has been done and**

**what can be concluded. Then there are exercises and problems at the end of each chapter for the reader to work on their own (with model programs given for that purpose).**

**Order, Disorder And Criticality - Advanced Problems Of Phase Transition Theory - Computer Simulation in Physics and Engineering**

**Monte Carlo Methods in Statistical Physics**

**Nucleation in Condensed Matter**

**With Web-Based Fortran Code**

**With Computer Applications, Second Edition**

**Innovations and Applications**

*This work is a needed reference for widely used techniques and methods of computer simulation in physics and other disciplines, such as materials science. The work conveys both: the theoretical foundations of computer simulation as well as applications and "tricks of the trade", that often are scattered across various papers. Thus it will meet a need and fill a gap for every scientist who needs computer simulations for his/her task at hand. In addition to being a reference, case studies and exercises for use as course reading are included.*

*Cellular automata make up a class of completely discrete dynamical systems, which have became a core subject in the sciences of complexity due to their conceptual simplicity, easiness of implementation for*

*computer simulation, and their ability to exhibit a wide variety of amazingly complex behavior. The feature of simplicity behind complexity of cellular automata has attracted the researchers' attention from a wide range of divergent fields of study of science, which extend from the exact disciplines of mathematical physics up to the social ones, and beyond. Numerous complex systems containing many discrete elements with local interactions have been and are being conveniently modelled as cellular automata. In this book, the versatility of cellular automata as models for a wide diversity of complex systems is underlined through the study of a number of outstanding problems using these innovative techniques for modelling and simulation.*

*What is superconductivity? How was it discovered? What are the properties of superconductors, how are they applied now, and how are they likely to become widely used in the near future? These are just some of the questions which this important book sets out to answer. Starting with the discovery of superconductivity over ninety years ago, the book guides the readers through the many years of subsequent exploration, right up to the latest sensational findings.Written in a lively, nontechnical style, this book makes ideal background reading for any school or college level study of superconductivity. The authors, who are leading authorities in the field, paint detailed pictures of the*

*phenomena involved without mathematical formalism, appealing instead to physical intuition.*

*CUDA is now the dominant language used for programming GPUs, one of the most exciting hardware developments of recent decades. With CUDA, you can use a desktop PC for work that would have previously required a large cluster of PCs or access to a HPC facility. As a result, CUDA is increasingly important in scientific and technical computing across the whole STEM community, from medical physics and financial modelling to big data applications and beyond. This unique book on CUDA draws on the author's passion for and long experience of developing and using computers to acquire and analyse scientific data. The result is an innovative text featuring a much richer set of examples than found in any other comparable book on GPU computing. Much attention has been paid to the C++ coding style, which is compact, elegant and efficient. A code base of examples and supporting material is available online, which readers can build on for their own projects.*

*Physics Briefs*

*Study of Two Dimensional Ising Model by Monte Carlo Simulation*

*Computer Simulation of a Two Dimensional Ising Model*

*Practical Time Series Analysis*

*Solid State PhysicsMetastable, Spintronics Materials and Mechanics of Deformable Bodies*

*Computational Modeling and Visualization of Physical Systems with Python*
*Second Edition*

This accessible new edition explores the major topics in Monte Carlo simulation that have arisen over the past 30 years and presents a sound foundation for problem solving Simulation and the Monte Carlo Method, Third Edition reflects the latest developments in the field and presents a fully updated and comprehensive account of the state-of-the-art theory, methods and applications that have emerged in Monte Carlo simulation since the publication of the classic First Edition over more than a quarter of a century ago. While maintaining its accessible and intuitive approach, this revised edition features a wealth of up-to-date information that facilitates a deeper understanding of problem solving across a wide array of subject areas, such as engineering, statistics, computer science, mathematics, and the physical and life sciences. The book begins with a modernized introduction that addresses the basic concepts of probability, Markov processes, and convex optimization. Subsequent chapters discuss the dramatic changes that have occurred in the field of the Monte Carlo method, with coverage of many modern topics including: Markov Chain Monte Carlo, variance reduction techniques such as importance (re-)sampling, and the transform likelihood ratio method, the score function method for sensitivity analysis, the stochastic approximation method and the stochastic counter-part method for Monte Carlo optimization, the cross-entropy method for rare events estimation and combinatorial

optimization, and application of Monte Carlo techniques for counting problems. An extensive range of exercises is provided at the end of each chapter, as well as a generous sampling of applied examples. The Third Edition features a new chapter on the highly versatile splitting method, with applications to rare-event estimation, counting, sampling, and optimization. A second new chapter introduces the stochastic enumeration method, which is a new fast sequential Monte Carlo method for tree search. In addition, the Third Edition features new material on: • Random number generation, including multiple-recursive generators and the Mersenne Twister • Simulation of Gaussian processes, Brownian motion, and diffusion processes • Multilevel Monte Carlo method • New enhancements of the cross-entropy (CE) method, including the "improved" CE method, which uses sampling from the zero-variance distribution to find the optimal importance sampling parameters • Over 100 algorithms in modern pseudo code with flow control • Over 25 new exercises Simulation and the Monte Carlo Method, Third Edition is an excellent text for upper-undergraduate and beginning graduate courses in stochastic simulation and Monte Carlo techniques. The book also serves as a valuable reference for professionals who would like to achieve a more formal understanding of the Monte Carlo method. Reuven Y. Rubinstein, DSc, was Professor Emeritus in the Faculty of Industrial Engineering and Management at Technion-Israel Institute of Technology. He served as a consultant at numerous large-scale organizations, such as IBM,

Motorola, and NEC. The author of over 100 articles and six books, Dr. Rubinstein was also the inventor of the popular score-function method in simulation analysis and generic cross-entropy methods for combinatorial optimization and counting. Dirk P. Kroese, PhD, is a Professor of Mathematics and Statistics in the School of Mathematics and Physics of The University of Queensland, Australia. He has published over 100 articles and four books in a wide range of areas in applied probability and statistics, including Monte Carlo methods, cross-entropy, randomized algorithms, tele-traffic c theory, reliability, computational statistics, applied probability, and stochastic modeling.

Standing as the first unified textbook on the subject, Liquid Crystals and Their Computer Simulations provides a comprehensive and up-to-date treatment of liquid crystals and of their Monte Carlo and molecular dynamics computer simulations. Liquid crystals have a complex physical nature, and, therefore, computer simulations are a key element of research in this field. This modern text develops a uniform formalism for addressing various spectroscopic techniques and other experimental methods for studying phase transitions of liquid crystals, and emphasises the links between their molecular organisation and observable static and dynamic properties. Aided by the inclusion of a set of Appendices containing detailed mathematical background and derivations, this book is accessible to a broad and multidisciplinary audience. Primarily intended for graduate students and academic researchers, it is also an invaluable reference for

industrial researchers working on the development of liquid crystal display technology.

Nucleation has been the subject of intense research because it plays an important role in the dynamics of most first-order phase transitions. The standard theory to describe the nucleation phenomena is the classical nucleation theory (CNT) because it correctly captures the qualitative features of the nucleation process. However potential problems with CNT have been suggested by previous studies. We systematically test the individual components of CNT by computer simulations of the Ising model and find that it accurately predicts the nucleation rate if the correct droplet free energy computed by umbrella sampling is provided as input. This validates the fundamental assumption of CNT that the system can be coarse grained into a one dimensional Markov chain with the largest droplet size as the reaction coordinate. Employing similar simulation techniques, we study the dislocation nucleation which is essential to our understanding of plastic deformation, ductility, and mechanical strength of crystalline materials. We show that dislocation nucleation rates can be accurately predicted over a wide range of conditions using CNT with the activation free energy determined by umbrella sampling. Our data reveal very large activation entropies, which contribute a multiplicative factor of many orders of magnitude to the nucleation rate. The activation entropy at constant strain is caused by thermal expansion, with negligible contribution from the vibrational entropy. The activation entropy at constant stress is significantly larger than that at

constant strain, as a result of thermal softening. The large activation entropies are caused by anharmonic effects, showing the limitations of the harmonic approximation widely used for rate estimation in solids. Similar behaviors are expected to occur in other nucleation processes in solids.

A completely revised edition that combines a comprehensive coverage of statistical and thermal physics with enhanced computational tools, accessibility, and active learning activities to meet the needs of today's students and educators This revised and expanded edition of Statistical and Thermal Physics introduces students to the essential ideas and techniques used in many areas of contemporary physics. Ready-to-run programs help make the many abstract concepts concrete. The text requires only a background in introductory mechanics and some basic ideas of quantum theory, discussing material typically found in undergraduate texts as well as topics such as fluids, critical phenomena, and computational techniques, which serve as a natural bridge to graduate study. Completely revised to be more accessible to students Encourages active reading with guided problems tied to the text Updated open source programs available in Java, Python, and JavaScript Integrates Monte Carlo and molecular dynamics simulations and other numerical techniques Self-contained introductions to thermodynamics and probability, including Bayes' theorem A fuller discussion of magnetism and the Ising model than other undergraduate texts Treats ideal classical and quantum

gases within a uniform framework Features a new chapter on transport coefficients and linear response theory Draws on findings from contemporary research Solutions manual (available only to instructors)

Programming in Parallel with CUDA Programming in Parallel with CUDA

Computer Simulation Studies in Condensed-Matter Physics V

Common Computational Approaches to Spin Glasses, Structural Glasses and Biological Macromolecules

International Conference San Francisco, CA, USA, May 28–30, 2001 Proceedings, Part I

Computer Simulation Studies in Condensed-Matter Physics XVII

Recent Progress

The Validity of Classical Nucleation Theory and Its Application to Dislocation Nucleation

Computational Modeling, by Jay Wang introduces computational modeling and visualization of physical systems that are commonly found in physics and related areas. The authors begin with a framework that integrates model building, algorithm development, and data visualization for problem solving via scientific computing. Through carefully selected problems, methods, and projects, the reader is guided to learning and discovery by actively doing rather than just knowing physics.

The five-volume set LNCS 3980-3984 constitutes the refereed proceedings of the International Conference on Computational Science and Its Applications,

ICCSA 2006. The volumes present a total of 664 papers organized according to the five major conference themes: computational methods, algorithms and applications high performance technical computing and networks advanced and emerging applications geometric modelling, graphics and visualization information systems and information technologies. This is Part V.

Since the appearance of Vol. 1 of Models of Neural Networks in 1991, the theory of neural nets has focused on two paradigms: information coding through coherent firing of the neurons and functional feedback. Information coding through coherent neuronal firing exploits time as a cardinal degree of freedom. This capacity of a neural network rests on the fact that the neuronal action potential is a short, say 1 ms, spike, localized in space and time. Spatial as well as temporal correlations of activity may represent different states of a network. In particular, temporal correlations of activity may express that neurons process the same "object" of, for example, a visual scene by spiking at the very same time. The traditional description of a neural network through a firing rate, the famous S-shaped curve, presupposes a wide time window of, say, at least 100 ms. It thus fails to exploit the capacity to "bind" sets of coherently firing neurons for the purpose of both scene segmentation and figure-ground segregation. Feedback is a dominant feature of the structural

organization of the brain. Recurrent neural networks have been studied extensively in the physical literature, starting with the ground breaking work of John Hop field (1982).

This book is a printed edition of the Special Issue "Complexity, Criticality and Computation (C $^{3}$ )" that was published in Entropy

Multiscale Phenomena And Their Simulation - Proceedings Of The International Conference

Prediction with Statistics and Machine Learning

Rugged Free Energy Landscapes

Markov Chain Monte Carlo Simulations and Their Statistical Analysis

With Web-based Fortran Code

Statistical Mechanics: Entropy, Order Parameters, and Complexity

Models of Neural Networks

***In this paper, we examine the statistical mechanics concepts of Boltzmann statistics, the Ising Model and the phase transition with the intent to show when the Ising model gives rise to a phase transition. We begin by deriving the Boltzmann factor and applying it to the simple case of a paramagnet in a magnetic field. We then introduce the one-dimensional Ising model and use a counting argument to argue that it exhibits no phase change. We then explore the two-dimensional square lattice Ising model. In particular, we use a method of simulation based on the metropolis algorithm to show that we expect***

*to find a phase change. We conclude by comparing the one-dimensional and two-dimensional Ising models.*

*Over ?fteen years ago, because of the tremendous increase in the power and utility of computer simulations, The University of Georgia formed the ?rst institutional unit devoted to the use of simulations in research and teaching: The Center for Simulational Physics. As the international simulations c- munityexpandedfurther,wesensedaneedforameetin gplaceforbothex- riencedsimulatorsandneophyte stodiscussnewtechniquesandrecentresults in an environment which promoted lively discussion. As a consequence, the Center for Simulational Physics established an annual workshop on Recent DevelopmentsinComputerSimulationStudie sinCondensedMatterPhysics. This year's workshop was the seventeenth in this series, and the continued interest shown by the scienti?c community demonstrates quite clearly the useful purpose that these meetings have served. The latest workshop was held at The University of Georgia, February 16-20, 2004, and these proce- ings provide a "status report" on a number of important topics. This volume is published with the goal of timely dissemination of the material to a wider audience. We wish to o?er a special thanks to IBM and to SGI for partial support of this year's workshop. This volume contains both invited papers and contributed presentations on problems in both classical and quantum condensed matter physics. We hope*

*that each reader will bene?t from specialized results as well as pro?t from exposure to new algorithms, methods of analysis, and conceptual dev- opments.*

*Studies of surfaces and interactions between dissimilar materials or phases are vital for modern technological applications. Computer simulation methods are indispensable in such studies and this book contains a substantial body of knowledge about simulation methods as well as the theoretical background for performing computer experiments and analyzing the data. The book is self-contained, covering a range of topics from classical statistical mechanics to a variety of simulation techniques, including molecular dynamics, Langevin dynamics and Monte Carlo methods. A number of physical systems are considered, including fluids, magnets, polymers, granular media, and driven diffusive systems. The computer simulation methods considered include both standard and accelerated versions. The simulation methods are clearly related to the fundamental principles of thermodynamics and statistical mechanics.*

*This book is the fifth volume of papers on advanced problems of phase transitions and critical phenomena, the first four volumes appeared in 2004, 2007, 2012, and 2015. It aims to compile reviews in those aspects of criticality and related subjects that are of current interest. The seven chapters discuss criticality of complex systems, where the*

*new, emergent properties appear via collective behaviour of simple elements. Since all complex systems involve cooperative behaviour between many interconnected components, the field of phase transitions and critical phenomena provides a very natural conceptual and methodological framework for their study. As the first four volumes, this book is based on the review lectures that were given in Lviv (Ukraine) at the "Ising lectures" — a traditional annual workshop on phase transitions and critical phenomena which aims to bring together scientists working in the field of phase transitions with university students and those who are interested in the subject. Contents: Statistical Properties of One-Dimensional Directed Polymers in a Random Potential (V Dotsenko)Non-Euclidean Geometry in Nature (S Nechaev)Dynamics of Polymers: Classic Results and Recent Developments (M V Tamm and K Polovnikov)Generalized Ensemble Computer Simulations of Macromolecules (W Janke)Photo-Controllable Networks in Macromolecular Solutions and Blends (J M Ilnytskyi)Monte Carlo Methods for Massively Parallel Computers (M Weigel)Complex Networks and Infrastructural Grids (A Scala) Readership: Advanced undergraduates and graduate students, researchers and scientists interested in phase transitions and critical phenomena. Keywords: Phase Transitions;Criticality;Scaling;Complex SystemsReview:0*

***A Practical Guide***

***Physikalische Berichte***
***Transition Matrix Monte Carlo Methods for Complex Systems***
***An Introduction***
***Applications in Materials and Biology***
***Computational Science and Its Applications – ICCSA 2006***

*Time series data analysis is increasingly important due to the massive production of such data through the internet of things, the digitalization of healthcare, and the rise of smart cities. As continuous monitoring and data collection become more common, the need for competent time series analysis with both statistical and machine learning techniques will increase. Covering innovations in time series data analysis and use cases from the real world, this practical guide will help you solve the most common data engineering and analysis challengesin time series, using both traditional statistical and modern machine learning techniques. Author Aileen Nielsen offers an accessible, well-rounded introduction to time series in both R and Python that will have data scientists, software engineers, and researchers up and running quickly. You'll get the guidance you need to confidently: Find and wrangle time series data Undertake exploratory time series data analysis Store temporal data Simulate time series data Generate and select features for a time series Measure error Forecast and classify time series with machine or deep learning Evaluate accuracy and performance*

*A new and updated edition of the successful Statistical Mechanics: Entropy, Order Parameters and Complexity from 2006. Statistical mechanics is a core topic in modern physics. Innovative, fresh introduction to the broad range of topics of statistical mechanics today, by brilliant teacher and renowned researcher.*

*When leaming very formal material one comes to a stage where*

*one thinks one has understood the material. Confronted with a "reallife" problem, the passivity of this understanding sometimes becomes painfully elear. To be able to solve the problem, ideas, methods, etc. need to be ready at hand. They must be mastered (become active knowledge) in order to employ them successfully. Starting from this idea, the leitmotif, or aim, of this book has been to elose this gap as much as possible. How can this be done? The material presented here was born out of a series of lectures at the Summer School held at Figueira da Foz (Portugal) in 1987. The series of lectures was split into two concurrent parts. In one part the "formal material" was presented. Since the background of those attending varied widely, the presentation of the formal material was kept as pedagogic as possible. In the formal part the general ideas behind the Monte Carlo method were developed. The Monte Carlo method has now found widespread appli cation in many branches of science such as physics, chemistry, and biology. Because of this, the scope of the lectures had to be narrowed down. We could not give a complete account and restricted the treatment to the ap plication of the Monte Carlo method to the physics of phase transitions. Here particular emphasis is placed on finite-size effects.*

*In Nucleation in Condensed Matter, key theoretical models for nucleation are developed and experimental data are used to discuss their range of validity. A central aim of this book is to enable the reader, when faced with a phenomenon in which nucleation appears to play a role, to determine whether nucleation is indeed important and to develop a quantitative and predictive description of the nucleation behavior. The third section of the book examines nucleation processes in practical situations, ranging from solid state precipitation to nucleation in biological systems to nucleation in food and drink. Nucleation in Condensed Matter is a key reference for an advanced materials course in phase transformations. It is also an essential reference for researchers in the field. Unified treatment of key theories, experimental*

*evaluations and case studies Complete derivation of key models Detailed discussion of experimental measurements Examples of nucleation in diverse systems*

*Markov Chain Monte Carlo*

*Computational Physics*

*The Two-Dimensional Ising Model*

*Monte Carlo Simulations of the Ising Model*

*Proceedings of the Fifth Workshop Athens, GA, USA, February 17–21, 1992*

*Proceedings of the Ninth Workshop Athens, GA, USA, March 4–9, 1996*

*Statistical and Thermal Physics*

**In this book, the thermodynamic observables of the classical one- and two-dimensional ferromagnetic and antiferromagnetic Ising models on a square lattice are simulated, especially at the phase transitions (if applicable) using the classical Monte Carlo algorithm of Metropolis. Finite size effects and the influence of an external magnetic field are described. The critical temperature of the 2d ferromagnetic Ising model is obtained using finite size scaling. Before presenting the Ising model, the basic concepts of statistical mechanics are recapped. Furthermore, the general principles of Monte Carlo methods are explained.**

**Monte Carlo Simulations of the Ising ModelAnchor Academic Publishing**

**This book teaches modern Markov chain Monte Carlo (MC) simulation techniques**

**step by step. The material should be accessible to advanced undergraduate students and is suitable for a course. It ranges from elementary statistics concepts (the theory behind MC simulations), through conventional Metropolis and heat bath algorithms, autocorrelations and the analysis of the performance of MC algorithms, to advanced topics including the multicanonical approach, cluster algorithms and parallel computing. Therefore, it is also of interest to researchers in the field. The book relates the theory directly to Web-based computer code. This allows readers to get quickly started with their own simulations and to verify many numerical examples easily. The present code is in Fortran 77, for which compilers are freely available. The principles taught are important for users of other programming languages, like C or C++.**

**This collection of lectures and tutorial reviews focuses on the common computational approaches in use to unravel the static and dynamical behaviour of complex physical systems at the interface of physics, chemistry and biology. Prominent consideration is given to rugged free-energy landscapes. The authors aim to provide a common basis and technical language for the (computational) technology transfer**

**between the fields and systems considered.**
**Monte Carlo Simulation in Statistical Physics**
**Simulation and the Monte Carlo Method**
**Complexity, Criticality and Computation (C³)**
**Annual Reviews of Computational Physics I**
**Recent Developments Proceedings of the Eighth Workshop Athens, GA, USA, February 20–24, 1995**