

Lectures On Quantum Information By Dagmar Bruss

Quantum computation and information is a new, rapidly developing interdisciplinary field. Therefore, it is not easy to understand its fundamental concepts and central results without facing numerous technical details. This book provides the reader a useful and not-too-heavy guide. It offers a simple and self-contained introduction; no previous knowledge of quantum mechanics or classical computation is required. Volume I may be used as a textbook for a one-semester introductory course in quantum information and computation, both for upper-level undergraduate students and for graduate students. It contains a large number of solved exercises, which are an essential complement to the text, as they will help the student to become familiar with the subject. The book may also be useful as general education for readers who want to know the fundamental principles of quantum information and computation and who have the basic background acquired from their undergraduate course in physics, mathematics, or computer science. Contents: Introduction to Classical Computation Introduction to Quantum Mechanics Quantum Computation Quantum Communication Readership: Upper-level undergraduates and graduate students in physics, mathematics and computer science. Keywords: Quantum Computation; Quantum Information; Quantum Algorithms; Quantum Communication; Quantum Cryptography; Complex Systems; Dynamical Systems; Quantum Chaos; Nanoscience; Quantum Optics Reviews: "The book by Benenti, Casati and Strini is an excellent introduction to the fascinating field of quantum computation and information. The reader is gently introduced to this field starting from the basics in computation and quantum mechanics to the more advanced topics of quantum computation of dynamical systems. The book is written in a very clear way, accessible both to undergraduate and graduate students in physics, computer science and engineering." Rosario Fazio Scuola Normale Superiore Pisa, Italy "The first volume of the present textbook aims at filling the gap between elementary introductory books and more advanced reference manuals. The choice of topics and the emphasis on concepts rather than mathematical technicalities makes it good choice for an introductory course of Quantum Information Theory for physicists or computer scientists with little background in this area. Of particular interest is the description of the links between quantum computation and quantum chaos, a research area in which the authors are leading experts, a topic rarely treated in introductory textbooks. The present volume is a welcomed addition to the existing choice of textbooks in quantum information theory and quantum computation." Professor G Massimo Palma University of Milan, Italy "This book gives a clear and exhaustive introduction to quantum computation and quantum communication. Together with the second volume it covers all the main topics in the field of quantum information theory. It is suited for a wide audience, ranging from computer scientists to physicists and engineers. It is an effective self-contained textbook for an introductory course in

quantum information theory and a precious tool for researchers who wish to approach the field.”Professor Chiara Macchiavello University of Pavia, Italy “The first volume of the two-volume edition is an introduction to the main concepts of quantum computation and information. The book offers a simple, clear and systematic treatment of qubits, quantum gates, various quantum algorithms and quantum communication. The chapters on classical information theory and quantum mechanics make the book easy to read. The book is recommended to undergraduate as well as graduate students in physics, mathematics and computer science. The large number of exercises is supplemented by solutions. The reader is encouraged for active work.”Professor Ioannis Antoniou Aristotle University of Thessaloniki, Greece “Besides giving an excellent introduction to the field it provides a unique perspective on the blending and cross-fertilization between the methods of quantum information and quantum chaos, both areas in which the authors are leading experts.”Marcos Saraceno Comision Nac. de Energia Atomica, Argentina “The authors have done a very good job, succeeding to present the main topics of this domain with remarkable concision and clarity.”Bertrand Georgeot CNRS/Universite Paul Sabatier, France “This book is, on the whole, well-written and readable. The material is presented concisely, and illustrated with simple examples and exercises ... the material in the current book is much more compact and easily learned than the phonebook-sized compendium of Nielsen and Chuang. It could serve well as the text for an introductory course ... It also contains numerous exercises, which mostly seem well thought out and appropriate to the material presented.”Mathematical Reviews “Reading this book one remarks from the very beginning that it is outstanding and well formulated with both mathematical and verbal respects ... This book is didactically well organized and written in a clear language. It can be best recommended to people to whom it is addressed by the authors.”Zentralblatt MATH '

Formal development of the mathematical theory of quantum information with clear proofs and exercises. For graduate students and researchers. Quantum Information Processing is a young and rapidly growing field of research at the intersection of physics, mathematics, and computer science. Its ultimate goal is to harness quantum physics to conceive -- and ultimately build -- "quantum" computers that would dramatically overtake the capabilities of today's "classical" computers. One example of the power of a quantum computer is its ability to efficiently find the prime factors of a larger integer, thus shaking the supposedly secure foundations of standard encryption schemes. This comprehensive textbook on the rapidly advancing field introduces readers to the fundamental concepts of information theory and quantum entanglement, taking into account the current state of research and development. It thus covers all current concepts in quantum computing, both theoretical and experimental, before moving on to the latest implementations of quantum computing and communication protocols. With its series of exercises, this is ideal reading for

students and lecturers in physics and informatics, as well as experimental and theoretical physicists, and physicists in industry. Dagmar Bruß graduated at RWTH University Aachen, Germany, and received her PhD in theoretical particle physics from the University of Heidelberg in 1994. As a research fellow at the University of Oxford she started to work in quantum information theory. Another fellowship at ISI Torino, Italy, followed. While being a research assistant at the University of Hannover she completed her habilitation. Since 2004 Professor Bruß has been holding a chair at the Institute of Theoretical Physics at the Heinrich-Heine-University Düsseldorf, Germany. Gerd Leuchs studied physics and mathematics at the University of Cologne, Germany, and received his Ph.D. in 1978. After two research visits at the University of Colorado in Boulder, USA, he headed the German gravitational wave detection group from 1985 to 1989. He became technical director at Nanomach AG in Switzerland. Since 1994 Professor Leuchs has been holding the chair for optics at the Friedrich-Alexander-University of Erlangen-Nuremberg, Germany. His fields of research span the range from modern aspects of classical optics to quantum optics and quantum information. Since 2003 he has been Director of the Max Planck Research Group for Optics, Information and Photonics at Erlangen.

"Nobel Laureate Steven Weinberg combines his exceptional physical insight with his gift for clear exposition to provide a concise introduction to modern quantum mechanics. Ideally suited to a one-year graduate course, this textbook is also a useful reference for researchers. Readers are introduced to the subject through a review of the history of quantum mechanics and an account of classic solutions of the Schrödinger equation, before quantum mechanics is developed in a modern Hilbert space approach. The textbook covers many topics not often found in other books on the subject, including alternatives to the Copenhagen interpretation, Bloch waves and band structure, the Wigner-Eckart theorem, magic numbers, isospin symmetry, the Dirac theory of constrained canonical systems, general scattering theory, the optical theorem, the 'in-in' formalism, the Berry phase, Landau levels, entanglement and quantum computing. Problems are included at the ends of chapters, with solutions available for instructors at www.cambridge.org/9781107028722"--

The 2002 Pan-American Advanced Studies Institute School on Quantum Gravity was held at the Centro de Estudios Científicos (CECS), Valdivia, Chile, January 4-14, 2002. The school featured lectures by ten speakers, and was attended by nearly 70 students from over 14 countries. A primary goal was to foster interaction and communication between participants from different cultures, both in the layman's sense of the term and in terms of approaches to quantum gravity. We hope that the links formed by students and the school will persist throughout their professional lives, continuing to promote interaction and the essential exchange of ideas that drives research forward. This volume contains improved and updated versions of the lectures given at the School. It has been prepared both as a reminder for the participants, and so that these pedagogical

introductions can be made available to others who were unable to attend. We expect them to serve students of all ages well.

The authors provide an introduction to quantum computing. Aimed at advanced undergraduate and beginning graduate students in these disciplines, this text is illustrated with diagrams and exercises.

Most of the matter in our universe is in a gaseous or plasma state. Yet, most textbooks on quantum statistics focus on examples from and applications in condensed matter systems, due to the prevalence of solids and liquids in our day-to-day lives. In an attempt to remedy that oversight, this book consciously focuses on teaching the subject matter in the context of (dilute) gases and plasmas, while aiming primarily at graduate students and young researchers in the field of quantum gases and plasmas for some of the more advanced topics. The majority of the material is based on a two-semester course held jointly by the authors over many years, and has benefited from extensive feedback provided by countless students and co-workers. The book also includes many historical remarks on the roots of quantum statistics: firstly because students appreciate and are strongly motivated by looking back at the history of a given field of research, and secondly because the spirit permeating this book has been deeply influenced by meetings and discussions with several pioneers of quantum statistics over the past few decades.

"Quantum computation, one of the latest joint ventures between physics and the theory of computation, is a scientific field whose main goals include the development of hardware and algorithms based on the quantum mechanical properties of those physical systems used to implement such algorithms."

"Solving difficult tasks (for example, the Satisfiability Problem and other NP-complete problems) requires the development of sophisticated algorithms, many of which employ stochastic processes as their mathematical basis. Discrete random walks are a popular choice among those stochastic processes." "Inspired on the success of discrete random walks in algorithm development, quantum walks, an emerging field of quantum computation, is a generalization of random walks into the quantum mechanical world." "The purpose of this lecture is to provide a concise yet comprehensive introduction to quantum walks."--BOOK JACKET.

Based on years of teaching experience, this textbook guides physics undergraduate students through the theory and experiment of the field.

Lecture Notes for Physics 229: Quantum Information and Computation By John Preskill
Quantum computation may seem to be a topic for science fiction, but small quantum computers have existed for several years and larger machines are on the drawing table. These efforts have been fueled by a tantalizing property: while conventional computers employ a binary representation that allows computational power to scale linearly with resources at best, quantum computations employ quantum phenomena that can interact to allow computational power that is exponential in the number of quantum bits in the system. Quantum devices rely on the ability to control and manipulate binary data stored in the phase information of quantum wave functions that

describe the electronic states of individual atoms or the polarization states of photons. While existing quantum technologies are in their infancy, we shall see that it is not too early to consider scalability and reliability. In fact, such considerations are a critical link in the development chain of viable device technologies capable of orchestrating reliable control of tens of millions quantum bits in a large-scale system. The goal of this lecture is to provide architectural abstractions common to potential technologies and explore the systems-level challenges in achieving scalable, fault-tolerant quantum computation. The central premise of the lecture is directed at quantum computation (QC) architectural issues. We stress the fact that the basic tenet of large-scale quantum computing is reliability through system balance: the need to protect and control the quantum information just long enough for the algorithm to complete execution. To architect QC systems, one must understand what it takes to design and model a balanced, fault-tolerant quantum architecture just as the concept of balance drives conventional architectural design. For example, the register file depth in classical computers is matched to the number of functional units, the memory bandwidth to the cache miss rate, or the interconnect bandwidth matched to the compute power of each element of a multiprocessor. We provide an engineering-oriented introduction to quantum computation and provide an architectural case study based upon experimental data and future projection for ion-trap technology. We apply the concept of balance to the design of a quantum computer, creating an architecture model that balances both quantum and classical resources in terms of exploitable parallelism in quantum applications. From this framework, we also discuss the many open issues remaining in designing systems to perform quantum computation.

Developing many of the major, exciting, pre- and post-millennium developments from the ground up, this book is an ideal entry point for graduate students into quantum information theory. Significant attention is given to quantum mechanics for quantum information theory, and careful studies of the important protocols of teleportation, superdense coding, and entanglement distribution are presented. In this new edition, readers can expect to find over 100 pages of new material, including detailed discussions of Bell's theorem, the CHSH game, Tsirelson's theorem, the axiomatic approach to quantum channels, the definition of the diamond norm and its interpretation, and a proof of the Choi–Kraus theorem. Discussion of the importance of the quantum dynamic capacity formula has been completely revised, and many new exercises and references have been added. This new edition will be welcomed by the upcoming generation of quantum information theorists and the already established community of classical information theorists.

Quantum information is an area of science, which brings together physics, information theory, computer science & mathematics. This book, which is based on two successful lecture courses, is intended to introduce readers to the ideas behind new developments including quantum cryptography, teleportation & quantum computing.

This book presents a concise introduction to an emerging and increasingly important topic, the theory of quantum computing. The development of quantum computing exploded in 1994 with the discovery of its use in factoring large numbers--an extremely difficult and time-consuming problem when using a conventional computer. In less than 300 pages, the authors set forth a solid foundation to the theory, including results that have not appeared elsewhere and improvements on existing works. The book starts

with the basics of classical theory of computation, including NP-complete problems and the idea of complexity of an algorithm. Then the authors introduce general principles of quantum computing and pass to the study of main quantum computation algorithms: Grover's algorithm, Shor's factoring algorithm, and the Abelian hidden subgroup problem. In concluding sections, several related topics are discussed (parallel quantum computation, a quantum analog of NP-completeness, and quantum error-correcting codes). This is a suitable textbook for a graduate course in quantum computing.

Prerequisites are very modest and include linear algebra, elements of group theory and probability, and the notion of an algorithm (on a formal or an intuitive level). The book is complete with problems, solutions, and an appendix summarizing the necessary results from number theory.

This book approaches condensed matter physics from the perspective of quantum information science, focusing on systems with strong interaction and unconventional order for which the usual condensed matter methods like the Landau paradigm or the free fermion framework break down. Concepts and tools in quantum information science such as entanglement, quantum circuits, and the tensor network representation prove to be highly useful in studying such systems. The goal of this book is to introduce these techniques and show how they lead to a new systematic way of characterizing and classifying quantum phases in condensed matter systems. The first part of the book introduces some basic concepts in quantum information theory which are then used to study the central topic explained in Part II: local Hamiltonians and their ground states. Part III focuses on one of the major new phenomena in strongly interacting systems, the topological order, and shows how it can essentially be defined and characterized in terms of entanglement. Part IV shows that the key entanglement structure of topological states can be captured using the tensor network representation, which provides a powerful tool in the classification of quantum phases. Finally, Part V discusses the exciting prospect at the intersection of quantum information and condensed matter physics – the unification of information and matter. Intended for graduate students and researchers in condensed matter physics, quantum information science and related fields, the book is self-contained and no prior knowledge of these topics is assumed.

Quantum information science is a rapidly developing field that not only promises a revolution in computer sciences but also touches deeply the very foundations of quantum physics. This book consists of a set of lectures by leading experts in the field that bridges the gap between standard textbook material and the research literature, thus providing the necessary background for postgraduate students and non-specialist researchers wishing to familiarize themselves with the subject thoroughly and at a high level. This volume is ideally suited as a course book for postgraduate students, and lecturers will find in it a large choice of material for bringing their courses up to date. This book is a comprehensive survey of most of the theoretical and experimental achievements in the field of quantum estimation of states and operations. Albeit still quite young, this field has already been recognized as a necessary tool for research in quantum optics and quantum information, beyond being a fascinating subject in its own right since it touches upon the conceptual foundations of quantum mechanics. The book consists of twelve extensive lectures that are essentially self-contained and modular, allowing combination of various chapters as a basis for advanced courses and seminars on theoretical or experimental aspects. The last two chapters, for instance, form a self-contained exposition on quantum

discrimination problems. The book will benefit graduate students and newcomers to the field as a high-level but accessible textbook, lecturers in search for advanced course material and researchers wishing to consult a modern and authoritative source of reference.

Quantum Annealing: From Viewpoints of Statistical Physics, Condensed Matter Physics, and Computational Physics (Shu Tanaka and Ryo Tamura); Spin Glass: A Bridge between Quantum Computation and Statistical Mechanics (Masayuki Ohzeki); Second Law-like Inequalities with Quantum Relative Entropy: An Introduction (Takahiro Sagawa).

Using the quantum properties of single photons to exchange binary keys between two partners for subsequent encryption of secret data is an absolutely novel technology. Only a few years ago quantum cryptography – or better Quantum Key Distribution – was the domain of basic research laboratories at universities. But during the last few years things changed. Quantum Key Distribution or QKD left the laboratories and was picked up by more practical-oriented teams that worked hard to develop a practically applicable technology out of the astonishing results of basic research. One major milestone toward a QKD technology was a large research and development project funded by the European Commission that aimed at combining quantum physics with complementary technologies that are necessary to create a technical solution: electronics, software, and network components were added within the project SECOQC (Development of a Global Network for Secure Communication based on Quantum Cryptography) that teamed up all expertise on European level to get a technology for future cryptography.

This graduate textbook provides a unified view of quantum information theory. Clearly explaining the necessary mathematical basis, it merges key topics from both information-theoretic and quantum-mechanical viewpoints and provides lucid explanations of the basic results. Thanks to this unified approach, it makes accessible such advanced topics in quantum communication as quantum teleportation, superdense coding, quantum state transmission (quantum error-correction) and quantum encryption. Since the publication of the preceding book *Quantum Information: An Introduction*, there have been tremendous strides in the field of quantum information. In particular, the following topics – all of which are addressed here – made seen major advances: quantum state discrimination, quantum channel capacity, bipartite and multipartite entanglement, security analysis on quantum communication, reverse Shannon theorem and uncertainty relation. With regard to the analysis of quantum security, the present book employs an improved method for the evaluation of leaked information and identifies a remarkable relation between quantum security and quantum coherence. Taken together, these two improvements allow a better analysis of quantum state transmission. In addition, various types of the newly discovered uncertainty relation are explained. Presenting a wealth of new developments, the book introduces readers to the latest advances and challenges in quantum information. To aid in understanding, each chapter is accompanied by a set of exercises and solutions.

This book provides readers with a concise introduction to current studies on operator-algebras and their generalizations, operator spaces and operator systems, with a special focus on their application in quantum information science. This basic framework for the mathematical formulation of quantum information can be traced back to the mathematical work of John von Neumann, one of the pioneers of operator algebras, which forms the underpinning of most current mathematical treatments of the quantum theory, besides being one of the most dynamic areas of twentieth century functional analysis. Today, von Neumann's foresight finds expression in the rapidly growing field of quantum information theory. These notes gather the content of lectures given by a very distinguished group of mathematicians and quantum information theorists, held at the IMSc in Chennai some years ago, and great care has been taken to present the material as a primer on the subject matter. Starting from the basic definitions of operator spaces and operator systems, this text proceeds to discuss several

important theorems including Stinespring's dilation theorem for completely positive maps and Kirchberg's theorem on tensor products of C^* -algebras. It also takes a closer look at the abstract characterization of operator systems and, motivated by the requirements of different tensor products in quantum information theory, the theory of tensor products in operator systems is discussed in detail. On the quantum information side, the book offers a rigorous treatment of quantifying entanglement in bipartite quantum systems, and moves on to review four different areas in which ideas from the theory of operator systems and operator algebras play a natural role: the issue of zero-error communication over quantum channels, the strong subadditivity property of quantum entropy, the different norms on quantum states and the corresponding induced norms on quantum channels, and, lastly, the applications of matrix-valued random variables in the quantum information setting.

This short and concise primer takes the vantage point of theoretical physics and the unity of physics. It sets out to strip the burgeoning field of quantum information science to its basics by linking it to universal concepts in physics. An extensive lecture rather than a comprehensive textbook, this volume is based on courses delivered over several years to advanced undergraduate and beginning graduate students, but essentially it addresses anyone with a working knowledge of basic quantum physics. Readers will find these lectures a most adequate entry point for theoretical studies in this field. For the second edition, the authors has succeeded in adding many new topics while sticking to the conciseness of the overall approach. A new chapter on qubit thermodynamics has been added, while new sections and subsections have been incorporated in various chapter to deal with weak and time-continuous measurements, period-finding quantum algorithms and quantum error corrections. From the reviews of the first edition: "The best things about this book are its brevity and clarity. In around 100 pages it provides a tutorial introduction to quantum information theory, including problems and solutions. ... it's worth a look if you want to quickly get up to speed with the language and central concepts of quantum information theory, including the background classical information theory." (Craig Savage, Australian Physics, Vol. 44 (2), 2007)

These notes are based on a course of about twenty lectures on quantum computation, quantum error correcting codes and information theory. Shor's Factorization algorithm, Knill-Laflamme theory of error correcting quantum codes and the basic ideas of classical and quantum information theory are discussed. The only background expected of the reader is familiarity with linear algebra in finite dimensional complex vector space and elementary probability theory.

The main purpose of this volume is to emphasize the multidisciplinary aspects of this very active new line of research in which concrete technological and industrial realizations require the combined efforts of experimental and theoretical physicists, mathematicians and engineers. Contents: Coherent Quantum Control of n -Atoms through the Stochastic Limit (L Accardi et al.); Recent Advances in Quantum White Noise Calculus (L Accardi & A Boukas); Joint Extension of States of Fermion Subsystems (H Araki); Fidelity of Quantum Teleportation Model Using Beam Splittings (K-H Fichtner et al.); Quantum Logical Gates Realized by Beam Splittings (W Freudenberg et al.); Noncanonical Representations of a Multi-dimensional Brownian Motion (Y Hibino); Information, Innovation and Elemental Random Field (T Hida); Generalized Sectors and Adjunctions to Control MicroCoMacro Transitions (I Ojima); Saturation of an Entropy Bound and Quantum Markov States (D Petz); An Infinite Dimensional Laplacian Acting on Some Class of $L(r)$ vy White Noise Functionals (K Sait); Structure of Linear Processes (S Si & W W Htay); Group Theory of Dynamical Maps (E C G Sudarshan); Quantum Entanglement, Purification, and Linear-optics Quantum Gates with Photonic Qubits (P Walther & A Zeilinger); On Quantum Mutual Type Measures and Capacity (N Watanabe); and other papers. Readership: Researchers in quantum physics and theoretical physics." First-ever comprehensive introduction to the major new subject of quantum computing

and quantum information.

Takes students and researchers on a tour through some of the deepest ideas of maths, computer science and physics.

This book is a collection of lecture notes from the Symposium on Quantum Computing, Thermodynamics, and Statistical Physics, held at Kinki University in March 2012.

Quantum information theory has a deep connection with statistical physics and thermodynamics. This volume introduces some of the topics on interface among the mentioned fields. Subjects included in the lecture notes include quantum annealing method, nonequilibrium thermodynamics and spin glass theory, among others. These subjects were presented with much emphasis put in its relevance in quantum information theory. These lecture notes are prepared in a self-contained manner so that a reader with modest background may understand the subjects.

A leisurely but mathematically honest presentation of quantum mechanics for graduate students in mathematics with an interest in physics.

Four concise, brilliant lectures on mathematical methods in quantum mechanics from Nobel Prize-winning quantum pioneer build on idea of visualizing quantum theory through the use of classical mechanics.

When, in 1984-86, Richard P. Feynman gave his famous course on computation at the California Institute of Technology, he asked Tony Hey to adapt his lecture notes into a book. Although led by Feynman, the course also featured, as occasional guest speakers, some of the most brilliant men in science at that time, including Marvin Minsky, Charles Bennett, and John Hopfield. Although the lectures are now thirteen years old, most of the material is timeless and presents a "Feynmanesque" overview of many standard and some not-so-standard topics in computer science such as reversible logic gates and quantum computers.

A quantum computer is a computer based on a computational model which uses quantum mechanics, which is a subfield of physics to study phenomena at the micro level. There has been a growing interest on quantum computing in the 1990's and some quantum computers at the experimental level were recently implemented.

Quantum computers enable super-speed computation and can solve some important problems whose solutions were regarded impossible or intractable with traditional computers. This book provides a quick introduction to quantum computing for readers who have no backgrounds of both theory of computation and quantum mechanics.

"Elements of Quantum Computing" presents the history, theories and engineering applications of quantum computing. The book is suitable to computer scientists, physicists and software engineers.

This book offers a concise review of quantum radar theory. Our approach is pedagogical, making emphasis on the physics behind the operation of a hypothetical quantum radar. We concentrate our discussion on the two major models proposed to date: interferometric quantum radar and quantum illumination. In addition, this book offers some new results, including an analytical study of quantum interferometry in the X-band radar region with a variety of atmospheric conditions, a derivation of a quantum radar equation, and a discussion of quantum radar jamming. This book assumes the reader is familiar with the basic principles of non-relativistic quantum mechanics, special relativity, and classical electrodynamics. Our discussion of quantum electrodynamics and its application to quantum radar is brief, but all the relevant

equations are presented in the text. In addition, the reader is not required to have any specialized knowledge on classical radar theory. Table of Contents: Introduction / The Photon / Photon Scattering / Classical Radar Theory / Quantum Radar Theory / Quantum Radar Cross Section / Conclusions

These three lectures cover a certain aspect of complexity and black holes, namely the relation to the second law of thermodynamics. The first lecture describes the meaning of quantum complexity, the analogy between entropy and complexity, and the second law of complexity. Lecture two reviews the connection between the second law of complexity and the interior of black holes. Prof. L. Susskind discusses how firewalls are related to periods of non-increasing complexity which typically only occur after an exponentially long time. The final lecture is about the thermodynamics of complexity, and “uncomplexity” as a resource for doing computational work. The author explains the remarkable power of “one clean qubit,” in both computational terms and in space-time terms. This book is intended for graduate students and researchers who want to take the first steps towards the mysteries of black holes and their complexity. This concise and readable book addresses primarily readers with a background in classical statistical physics and introduces quantum mechanical notions as required. Conceived as a primer to bridge the gap between statistical physics and quantum information, it emphasizes concepts and thorough discussions of the fundamental notions and prepares the reader for deeper studies, not least through a selection of well chosen exercises.

The multidisciplinary field of quantum computing strives to exploit some of the uncanny aspects of quantum mechanics to expand our computational horizons. Quantum Computing for Computer Scientists takes readers on a tour of this fascinating area of cutting-edge research. Written in an accessible yet rigorous fashion, this book employs ideas and techniques familiar to every student of computer science. The reader is not expected to have any advanced mathematics or physics background. After presenting the necessary prerequisites, the material is organized to look at different aspects of quantum computing from the specific standpoint of computer science. There are chapters on computer architecture, algorithms, programming languages, theoretical computer science, cryptography, information theory, and hardware. The text has step-by-step examples, more than two hundred exercises with solutions, and programming drills that bring the ideas of quantum computing alive for today's computer science students and researchers.

This comprehensive textbook on the rapidly advancing field introduces readers to the fundamental concepts of information theory and quantum entanglement, taking into account the current state of research and development. It thus covers all current concepts in quantum computing, both theoretical and experimental, before moving on to the latest implementations of quantum computing and communication protocols. It contains problems and exercises and is therefore ideally suited for students and lecturers in physics and informatics, as well as experimental and theoretical physicists in academia and industry who work in the field of quantum information processing. The second edition incorporates important recent developments such as quantum metrology, quantum correlations beyond entanglement, and advances in quantum computing with solid state devices.

Perspectives in Computation covers three broad topics: the computation process & its limitations; the search for computational efficiency; & the role of quantum mechanics in computation.

Lectures on Quantum Information Wiley-VCH

Covering the theory of computation, information and communications, the physical aspects of computation, and the physical limits of computers, this text is based on the notes taken by one of its editors, Tony Hey, on a lecture course on computation given b

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