

Quantum Algorithms



An Introduction To Quantum Computing Algorithms

Richard J. Lipton, Kenneth W. Regan



An Introduction To Quantum Computing Algorithms:

An Introduction to Quantum Computing Algorithms Arthur O. Pittenger, 2012-12-06 In 1994 Peter Shor 65 published a factoring algorithm for a quantum computer that finds the prime factors of a composite integer N more efficiently than is possible with the known algorithms for a classical computer Since the difficulty of the factoring problem is crucial for the security of a public key encryption system interest and funding in quantum computing and quantum computation suddenly blossomed Quantum computing had arrived The study of the role of quantum mechanics in the theory of computation seems to have begun in the early 1980s with the publications of Paul Benioff 6 7 who considered a quantum mechanical model of computers and the computation process A related question was discussed shortly thereafter by Richard Feynman 35 who began from a different perspective by asking what kind of computer should be used to simulate physics His analysis led him to the belief that with a suitable class of quantum machines one could imitate any quantum system

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An Introduction to Quantum Computing Algorithms Arthur O. Pittenger, 2000 The purpose of this monograph is to provide the mathematically literate reader with an accessible introduction to the theory of quantum computing algorithms one component of a fascinating and rapidly developing area which involves topics from physics mathematics and computer science This text is a good self contained introductory resource for newcomers to the field of quantum computing algorithms as well as a useful self study guide for the more specialized scientist mathematician graduate student or engineer Readers interested in following the ongoing developments of quantum algorithms will benefit particularly from this presentation of the notation and basic theory

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An Introduction to Quantum Computing Phillip Kaye, Raymond Laflamme, Michele Mosca, 2006-11-17 This concise accessible text provides a thorough introduction to quantum computing an exciting emergent field at the interface of the computer engineering mathematical and physical sciences Aimed at advanced undergraduate and beginning graduate students in these disciplines the text is technically detailed and is clearly illustrated throughout with diagrams and exercises Some prior knowledge of linear algebra

is assumed including vector spaces and inner products However prior familiarity with topics such as quantum mechanics and computational complexity is not required **Introduction to Quantum Algorithms** Johannes A. Buchmann,2024-03-18

Quantum algorithms are among the most important interesting and promising innovations in information and communication technology They pose a major threat to today s cybersecurity and at the same time promise great benefits by potentially solving previously intractable computational problems with reasonable effort The theory of quantum algorithms is based on advanced concepts from computer science mathematics and physics Introduction to Quantum Algorithms offers a mathematically precise exploration of these concepts accessible to those with a basic mathematical university education while also catering to more experienced readers This comprehensive book is suitable for self study or as a textbook for one or two semester introductory courses on quantum computing algorithms Instructors can tailor their approach to emphasize theoretical understanding and proofs or practical applications of quantum algorithms depending on the course s goals and timeframe *Introduction to Quantum Algorithms via Linear Algebra, second edition* Richard J. Lipton,Kenneth W.

Regan,2021-04-06 Quantum computing explained in terms of elementary linear algebra emphasizing computation and algorithms and requiring no background in physics This introduction to quantum algorithms is concise but comprehensive covering many key algorithms It is mathematically rigorous but requires minimal background and assumes no knowledge of quantum theory or quantum mechanics The book explains quantum computation in terms of elementary linear algebra it assumes the reader will have some familiarity with vectors matrices and their basic properties but offers a review of the relevant material from linear algebra By emphasizing computation and algorithms rather than physics it makes quantum algorithms accessible to students and researchers in computer science who have not taken courses in quantum physics or delved into fine details of quantum effects apparatus circuits or theory *A Practical Guide to Quantum Computing* Elías F. Combarro,Samuel González-Castillo,2025-07-30 Learn about quantum information processing with Qiskit through hands on projects A foundational resource for STEM professionals researchers and university students interested in quantum computers and algorithms Key Features Understand the theoretical foundations of quantum computing Learn how to use the Qiskit framework and how to run quantum algorithms with it Discover top quantum algorithms like Grover s search and Shor s factoring methods Purchase of the print or Kindle book includes a free PDF eBook Book Description This book is an introduction from scratch to quantum computing and the most important and foundational quantum algorithms ranging from humble protocols such as Deutsch s algorithm to ones with far reaching potential such as Shor s factoring algorithm offering clear explanations and a hands on approach with runnable code on simulators and real hardware The book is self contained and does not assume any previous experience in quantum computing Starting with a single qubit it scales to algorithms using superposition and entanglement At every step examples of applications are provided including how to create quantum money that is impossible to forge quantum cryptography that cannot be broken and algorithms for searching and factoring that are

much faster than those that regular non quantum computers can use Code for each of these algorithms is provided and explained in detail using Qiskit 2 1 After reading this book you will understand how quantum algorithms work how to write your own quantum programs and how to run them on quantum simulators and actual quantum computers You will also be prepared to take the jump into quantum algorithms for optimization and artificial intelligence like those presented in our previous book A Practical Guide to Quantum Machine Learning and Quantum Optimization What you will learn Understand what makes a quantum computer unique Mathematically represent the state of multi qubit systems Describe the effects of measurements in quantum computers Know how quantum superposition entanglement and interference work Implement and run any quantum algorithm in Qiskit Understand how Shor s and Grover s algorithms work Gain familiarity with quantum fault tolerance and quantum advantage Who this book is for This book would be ideal for university level students in Computer Science Mathematics Physics or other STEM fields taking introductory level courses on quantum computing It also suits professionals researchers and self learners with a STEM background Potential readers of our previous book A Practical Guide to Quantum Machine Learning and Quantum Optimization will benefit from first building foundational quantum computing skills with this book

Introduction to Quantum Computation Ioan Burda,2005 Introduction to Quantum Computation is an introduction to a new rapidly developing theory of quantum computing The book is a comprehensive introduction to the main ideas and techniques of quantum computation It begins with the basics of classical theory of computation NP complete problems Boolean circuits Finite state machine Turing machine and the idea of complexity of an algorithm The general quantum formalism pure states qubit superposition evolution of quantum system entanglement multi qubit system and complex algorithm examples are also presented Matlab is a well known in engineer academia as matrix computing environment which makes it well suited for simulating quantum algorithms The Quantum Computer Toolbox QCT is written entirely in the Matlab and m files are listed in book s sections There are certain data types that are implicitly defined by the QCT including data types for qubit registers and transformations The QCT contains many functions designed to mimic the actions of a quantum computer In addition the QCT contains several convenience functions designed to aid in the creation and modification of the data types used in algorithms The main purposes of the QCT are for research involving Quantum Computation and as a teaching tool to aid in learning about Quantum Computing systems The readers will learn to implement complex quantum algorithm quantum teleportation and Deutsch Grover Shor algorithm under Matlab environment complete Matlab code examples

Introduction to Quantum Computing Hiu Yung Wong,2022-05-24 This textbook introduces quantum computing to readers who do not have much background in linear algebra The author targets undergraduate and master students as well as non CS and non EE students who are willing to spend about 60 90 hours seriously learning quantum computing Readers will be able to write their program to simulate quantum computing algorithms and run on real quantum computers on IBM Q Moreover unlike the books that only give superficial hand waving

explanations this book uses exact formalism so readers can continue to pursue more advanced topics based on what they learn from this book Encourages students to embrace uncertainty over the daily classical experience when encountering quantum phenomena Uses narrative to start each section with analogies that help students to grasp the critical concept quickly Uses numerical substitutions accompanied by Python programming and IBM Q quantum computer programming as examples in teaching all critical concepts

Quantum Computers, Algorithms and Chaos G. Casati,D.L..

Shepelyansky,P. Zoller,2006-12-19 During the last ten years Quantum Information Processing and Communication QIPC has established itself as one of the new hot topic fields in physics with the potential to revolutionize many areas of science and technology QIPC replaces the laws of classical physics applied to computation and communication with the more fundamental laws of quantum mechanics This becomes increasingly important due to technological progress going down to smaller and smaller scales where quantum effects start to be dominant In addition to its fundamental nature QIPC promises to advance computing power beyond the capabilities of any classical computer to guarantee secure communication and establish direct links to emerging quantum technologies such as for example quantum based sensors and clocks One of the outstanding feature of QIPC is its interdisciplinary character it brings together researchers from physics mathematics and computer science In particular within physics we have seen the emergence of a new QIPC community which ranges from theoretical to experimental physics and crosses boundaries of traditionally separated disciplines such as atomic physics quantum optics statistical mechanics and solid state physics all working on different and complementary aspects of QIPC This publication covers the following topics Introduction to quantum computing Quantum logic information and entanglement Quantum algorithms Error correcting codes for quantum computations Quantum measurements and control Quantum communication Quantum optics and cold atoms for quantum information Quantum computing with solid state devices Theory and experiments for superconducting qubits Interactions in many body systems quantum chaos disorder and random matrices Decoherence effects for quantum computing and Future prospects of quantum information processing

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