# Quantum Radar Synthesis Lectures On Quantum Computing

Ensemble methods have been called the most influential development in Data Mining and Machine Learning in the past decade. They combine multiple models into one usually more accurate than the best of its components. Ensembles can provide a critical boost to industrial challenges -- from investment timing to drug discovery, and fraud detection to recommendation systems -- where predictive accuracy is more vital than model interpretability. Ensembles are useful with all modeling algorithms, but this book focuses on decision trees to explain them most clearly. After describing trees and their strengths and weaknesses, the authors provide an overview of regularization -- today understood to be a key reason for the superior performance of modern ensembling algorithms. The book continues with a clear description of two recent developments: Importance Sampling (IS) and Rule Ensembles (RE). IS reveals classic ensemble methods -- bagging, random forests, and boosting -- to be special cases of a single algorithm, thereby showing how to improve their accuracy and speed. REs are linear rule models derived from decision tree ensembles. They are the most interpretable version of ensembles, which is essential to applications such as credit scoring and fault diagnosis. Lastly, the authors explain the paradox of how ensembles achieve greater accuracy on new data despite their (apparently much greater) complexity. This book is aimed at novice and advanced analytic researchers and practitioners -- especially in Engineering, Statistics, and Computer Science. Those with little exposure to ensembles will learn why and how to employ this

breakthrough method, and advanced practitioners will gain insight into building even more powerful models. Throughout, snippets of code in R are provided to illustrate the algorithms described and to encourage the reader to try the techniques. The authors are industry experts in data mining and machine learning who are also adjunct professors and popular speakers. Although early pioneers in discovering and using ensembles, they here distill and clarify the recent groundbreaking work of leading academics (such as Jerome Friedman) to bring the benefits of ensembles to practitioners. Table of Contents: Ensembles Discovered / Predictive Learning and Decision Trees / Model Complexity, Model Selection and Regularization / Importance Sampling and the Classic Ensemble Methods / Rule Ensembles and Interpretation Statistics / Ensemble Complexity

This book is concerned with the models of quantum computation. Information processing based on the rules of quantum mechanics provides us with new opportunities for developing more efficient algorithms and protocols. However, to harness the power offered by quantum information processing it is essential to control the behavior of quantum mechanical objects in a precise manner. As this seems to be conceptually difficult at the level of quantum states and unitary gates, high-level quantum programming languages have been proposed for this purpose. The aim of this book is to provide an introduction to abstract models of computation used in quantum information theory. Starting from the abstract models of Turing machine and finite automata, we introduce the models of Boolean circuits and Random Access Machine and use them to present quantum programming techniques and quantum programming languages. Table of Contents: Introduction / Turing machines / Quantum Finite State Automata / Computational Circuits / Random Access Machines / Quantum Programming Environment /

Quantum Programming Languages / Imperative quantum programming / Functional Quantum Programming / Outlook

Volume XIII includes scientific articles and reports from the 16th International Scientific Conference on the topic of „The science and digitalisation in help of business, education and tourism“, September 7th -8th , 2020, Varna, Bulgaria.

The first IUPAC Manual of Symbols and Terminology for Physicochemical Quantities and Units (the Green Book) of which this is the direct successor, was published in 1969, with the object of 'securing clarity and precision, and wider agreement in the use of symbols, by chemists in different countries, among physicists, chemists and engineers, and by editors of scientific journals'. Subsequent revisions have taken account of many developments in the field, culminating in the major extension and revision represented by the 1988 edition under the simplified title Quantities, Units and Symbols in Physical Chemistry. This 2007, Third Edition, is a further revision of the material which reflects the experience of the contributors with the previous editions. The book has been systematically brought up to date and new sections have been added. It strives to improve the exchange of scientific information among the readers in different disciplines and across different nations. In a rapidly expanding volume of scientific literature where each discipline has a tendency to retreat into its own jargon this book attempts to provide a readable compilation of widely used terms and symbols from many sources together with brief understandable definitions. This is the definitive guide for scientists and organizations working across a multitude of disciplines requiring internationally approved nomenclature.

Highly effective thinking is an art that engineers and scientists can be taught to develop. By

presenting actual experiences and analyzing them as they are described, the author conveys the developmental thought processes employed and shows a style of thinking that leads to successful results is something that can be learned. Along with spectacular successes, the author also conveys how failures contributed to shaping the thought processes. Provides the reader with a style of thinking that will enhance a person's ability to function as a problem-solver of complex technical issues. Consists of a collection of stories about the author's participation in significant discoveries, relating how those discoveries came about and, most importantly, provides analysis about the thought processes and reasoning that took place as the author and his associates progressed through engineering problems.

This book recalls the basics required for an understanding of the nanoworld (quantum physics, molecular biology, micro and nanoelectronics) and gives examples of applications in various fields: materials, energy, devices, data management and life sciences. It is clearly shown how the nanoworld is at the crossing point of knowledge and innovation. Written by an expert who spent a large part of his professional life in the field, the title also gives a general insight into the evolution of nanosciences and nanotechnologies. The reader is thus provided with an introduction to this complex area with different "tracks" for further personal comprehension and reflection. This guided and illustrated tour also reveals the importance of the nanoworld in everyday life.

In this book, a general frequency domain numerical method similar to the finite difference frequency domain (FDFD) technique is presented. The proposed method, called the multiresolution frequency domain (MRFD) technique, is based on orthogonal Battle-Lemarie and biorthogonal Cohen-Daubechies-Feauveau (CDF) wavelets. The objective of developing

this new technique is to achieve a frequency domain scheme which exhibits improved computational efficiency figures compared to the traditional FDFD method: reduced memory and simulation time requirements while retaining numerical accuracy. The newly introduced MRFD scheme is successfully applied to the analysis of a number of electromagnetic problems, such as computation of resonance frequencies of one and three dimensional resonators, analysis of propagation characteristics of general guided wave structures, and electromagnetic scattering from two dimensional dielectric objects. The efficiency characteristics of MRFD techniques based on different wavelets are compared to each other and that of the FDFD method. Results indicate that the MRFD techniques provide substantial savings in terms of execution time and memory requirements, compared to the traditional FDFD method. Table of Contents: Introduction / Basics of the Finite Difference Method and Multiresolution Analysis / Formulation of the Multiresolution Frequency Domain Schemes / Application of MRFD Formulation to Closed Space Structures / Application of MRFD Formulation to Open Space Structures / A Multiresolution Frequency Domain Formulation for Inhomogeneous Media / Conclusion

This book brings together reviews by internationally renowned experts on quantum optics and photonics. It describes novel experiments at the limit of single photons, and presents advances in this emerging research area. It also includes reprints and historical descriptions of some of the first pioneering experiments at a single-photon level and nonlinear optics, performed before the inception of lasers and modern light detectors, often with the human eye serving as a single-photon detector. The book comprises 19 chapters, 10 of which describe modern quantum photonics results, including single-photon sources, direct measurement of the

photon's spatial wave function, nonlinear interactions and non-classical light, nanophotonics for room-temperature single-photon sources, time-multiplexed methods for optical quantum information processing, the role of photon statistics in visual perception, light-by-light coherent control using metamaterials, nonlinear nanoplasmonics, nonlinear polarization optics, and ultrafast nonlinear optics in the mid-infrared.

Quantum information processing offers fundamental improvements over classical information processing, such as computing power, secure communication, and high-precision measurements. However, the best way to create practical devices is not yet known. This textbook describes the techniques that are likely to be used in implementing optical quantum information processors. After developing the fundamental concepts in quantum optics and quantum information theory, the book shows how optical systems can be used to build quantum computers according to the most recent ideas. It discusses implementations based on single photons and linear optics, optically controlled atoms and solid-state systems, atomic ensembles, and optical continuous variables. This book is ideal for graduate students beginning research in optical quantum information processing. It presents the most important techniques of the field using worked examples and over 120 exercises.

This book presents basic geometric and algebraic properties of the Heisenberg group and its relation to the skew field of quaternions, symplectic structures and representations, and describes some of its applications. It offers a clear exposition of mathematical topics referring to applications in signal theory, physics and information theory. It has relevance for undergraduate and graduate students, a variety of researchers, and specialists in data processing.

Bell's Theorem and its associated implications for the nature of the physical world remain topics of great interest. For this reason many meetings have been recently held on the interpretation of quantum theory and the implications of Bell's Theorem. Generally these meetings have been held primarily for quantum physicists and philosophers of science who have been or are actively working on the topic. Nevertheless, other philosophers of science, mathematicians, engineers as well as members of the general public have increasingly taken interest in Bell's Theorem and its implications. The Fall Workshop held at George Mason University on October 21 and 22, 1988 and titled "Bell's Theorem, Quantum Theory and Conceptions of the Universe" was of a more general scope. Not only it attracted experts in the field, it also covered other topics such as the implications of quantum non-locality for the nature of consciousness, cosmology, the anthropic principle, etc. topics usually not covered in previous meetings of this kind. The meeting was attended by more than one hundred ten specialists and other interested people from all over the world. The purpose of the meeting was not to provide a definitive answer to the general questions raised by Bell's Theorem. It is likely that the debate will go on for quite a long time. Rather, it was meant to contribute to the important dialogue between different disciplines.

It should appeal to plasma physicists interested in charged-particle dynamics, as well as to applied physicists needing to know more about micro- and millimeter-wave technologies.

Synthetic Aperture Radar Imaging Mechanism for Oil Spills delivers the critical tool needed to understand the latest technology in radar imaging of oil spills, particularly microwave radar as a main source to understand analysis and applications in the field of marine pollution. Filling the gap between modern physics quantum theory and applications of radar imaging of oil spills,

this reference is packed with technical details associated with the potentiality of synthetic aperture radar (SAR) and the key methods used to extract the value-added information necessary, such as location, size, perimeter and chemical details of the oil slick from SAR measurements. Rounding out with practical simulation trajectory movements of oil spills using radar images, this book brings an effective new source of technology and applications for today's oil and marine pollution engineers. Bridges the gap between theory and application of the techniques involving oil spill monitoring Helps readers understand a new approach to four-dimensional automatic detection Provides advanced knowledge on image processing based on intelligent learning machine algorithms and new techniques for detection, such as quantum and multi-objective algorithms

A global expansion of consciousness is underway. As predicted by ancient prophecy, old ways of thinking and of seeing the world are shifting. Mind-stretching new phenomena are challenging current reality. New frontiers of science are disclosing a connection between our consciousness and physical reality. As consciousness changes, so do our perceptions. The door is opening to a new reality. Join Colin and Synthia as they explore what is beyond this door. Examine the multitude of current changes—from the bases of society to the foundations of science—that indicate the unfolding of a new paradigm. Investigate non-ordinary reality and unexplained phenomena as interactions of consciousness. In this fascinating new title, you will explore and learn about: Parallel cases of inexplicable exchanges between lights in the sky and crop circles on the ground Strange sounds in the sky heard and recorded around the world Photographic orbs of light The Norway Spiral, a rotating spiral of light seen by hundreds of people in 2009 Unexplained RADAR interference patterns correlating with weather anomalies

This book tells the story of the second quantum revolution which will shape the 21st century as much as the first quantum revolution shaped the 20th century. It provides unique orientation in today's discussion and the latest progress on the interpretation of quantum physics and its further technological potential. As you read this book the first prototypes of this revolution are being built in laboratories worldwide. Super-technologies such as nanotechnology, quantum computers, quantum information processing, and others will soon shape our daily lives, even if physicists themselves continue to disagree on how to interpret the central theory of modern physics. The book will thus also touch on the profound philosophical questions at the heart of quantum mechanics.

Quantum robotics is an emerging engineering and scientific research discipline that explores the application of quantum mechanics, quantum computing, quantum algorithms, and related fields to robotics. This work broadly surveys advances in our scientific understanding and engineering of quantum mechanisms and how these developments are expected to impact the technical capability for robots to sense, plan, learn, and act in a dynamic environment. It also discusses the new technological potential that quantum approaches may unlock for sensing and control, especially for exploring and manipulating quantum-scale environments. Finally, the work surveys the state of the art in current implementations, along with their benefits and limitations, and provides a roadmap for the future.

The adiabatic quantum computation (AQC) is based on the adiabatic theorem to approximate solutions of the Schrödinger equation. The design of an AQC algorithm involves the construction of a Hamiltonian that describes the behavior of the quantum

system. This Hamiltonian is expressed as a linear interpolation of an initial Hamiltonian whose ground state is easy to compute, and a final Hamiltonian whose ground state corresponds to the solution of a given combinatorial optimization problem. The adiabatic theorem asserts that if the time evolution of a quantum system described by a Hamiltonian is large enough, then the system remains close to its ground state. An AQC algorithm uses the adiabatic theorem to approximate the ground state of the final Hamiltonian that corresponds to the solution of the given optimization problem. In this book, we investigate the computational simulation of AQC algorithms applied to the MAX-SAT problem. A symbolic analysis of the AQC solution is given in order to understand the involved computational complexity of AQC algorithms. This approach can be extended to other combinatorial optimization problems and can be used for the classical simulation of an AQC algorithm where a Hamiltonian problem is constructed. This construction requires the computation of a sparse matrix of dimension $2n \times 2n$, by means of tensor products, where n is the dimension of the quantum system. Also, a general scheme to design AQC algorithms is proposed, based on a natural correspondence between optimization Boolean variables and quantum bits. Combinatorial graph problems are in correspondence with pseudo-Boolean maps that are reduced in polynomial time to quadratic maps. Finally, the relation among NP-hard problems is investigated, as well as its logical representability, and is applied to the design of AQC algorithms. It is shown that every monadic second-order logic (MSOL)

expression has associated pseudo-Boolean maps that can be obtained by expanding the given expression, and also can be reduced to quadratic forms. Table of Contents: Preface / Acknowledgments / Introduction / Approximability of NP-hard Problems / Adiabatic Quantum Computing / Efficient Hamiltonian Construction / AQC for Pseudo-Boolean Optimization / A General Strategy to Solve NP-Hard Problems / Conclusions / Bibliography / Authors' Biographies

The theories and techniques that underlie radio interferometry as applied to astonomy and astrometry are discussed in this text. It is intended for graduate students and professionals who wish to use interferometric or synthesis-mapping techniques in astronomy, astrometry or geodesy.

The essential introduction to the principles and applications of feedback systems—now fully revised and expanded This textbook covers the mathematics needed to model, analyze, and design feedback systems. Now more user-friendly than ever, this revised and expanded edition of Feedback Systems is a one-volume resource for students and researchers in mathematics and engineering. It has applications across a range of disciplines that utilize feedback in physical, biological, information, and economic systems. Karl Åström and Richard Murray use techniques from physics, computer science, and operations research to introduce control-oriented modeling. They begin with state space tools for analysis and design, including stability of solutions, Lyapunov functions, reachability, state feedback observability, and estimators. The matrix

exponential plays a central role in the analysis of linear control systems, allowing a concise development of many of the key concepts for this class of models. Åström and Murray then develop and explain tools in the frequency domain, including transfer functions, Nyquist analysis, PID control, frequency domain design, and robustness. Features a new chapter on design principles and tools, illustrating the types of problems that can be solved using feedback Includes a new chapter on fundamental limits and new material on the Routh-Hurwitz criterion and root locus plots Provides exercises at the end of every chapter Comes with an electronic solutions manual An ideal textbook for undergraduate and graduate students Indispensable for researchers seeking a self-contained resource on control theory

Due to its extensive applications in stealth technology, much of the research effort in radar absorbing materials (RAM) has remained classified. As is the wont with classified topics, it has resulted in much awe and unfounded speculation. The aim of this book is to demystify this topic. The book in hand is concise but complete in itself. The attention of the readers is first drawn towards the historical evolution of RAM to emphasize that the elementary principles of electromagnetics lead to the fundamental concepts of RAM. These also form the basis for further mathematical analysis and design of RAM. The performance plots for the various RAM designs, to the extent possible, are taken with respect to power reflection; this should facilitate comparison of their relative performances. In order to further induce the reader to take the first step towards RAM

design, we have included the relevant computer codes in a companion diskette. This would enable the reader to try out elementary designs on his own. * .EXE files should facilitate ready execution of codes on most DOS based computing platforms. The corresponding source codes with comments are also included as * .FOR files. The reader may wish to modify some of these codes for examining RAM design algorithms further. We welcome comments from the reader on these codes.

One of the major scientific thrusts in recent years has been to try to harness quantum phenomena to increase dramatically the performance of a wide variety of classical information processing devices. In particular, it is generally accepted that quantum co

Adiabatic quantum computation (AQC) is an alternative to the better-known gate model of quantum computation. The two models are polynomially equivalent, but otherwise quite dissimilar: one property that distinguishes AQC from the gate model is its analog nature. Quantum annealing (QA) describes a type of heuristic search algorithm that can be implemented to run in the ``native instruction set'' of an AQC platform. D-Wave Systems Inc. manufactures {quantum annealing processor chips} that exploit quantum properties to realize QA computations in hardware. The chips form the centerpiece of a novel computing platform designed to solve NP-hard optimization problems. Starting with a 16-qubit prototype announced in 2007, the company has launched and sold increasingly larger models: the 128-qubit D-Wave One system was announced in 2010 and the 512-qubit D-Wave Two system arrived on the scene in 2013. A 1,000-qubit

model is expected to be available in 2014. This monograph presents an introductory overview of this unusual and rapidly developing approach to computation. We start with a survey of basic principles of quantum computation and what is known about the AQC model and the QA algorithm paradigm. Next we review the D-Wave technology stack and discuss some challenges to building and using quantum computing systems at a commercial scale. The last chapter reviews some experimental efforts to understand the properties and capabilities of these unusual platforms. The discussion throughout is aimed at an audience of computer scientists with little background in quantum computation or in physics.

Foreword. A transformed scientific method. Earth and environment. Health and wellbeing. Scientific infrastructure. Scholarly communication.

Semi-supervised learning is a learning paradigm concerned with the study of how computers and natural systems such as humans learn in the presence of both labeled and unlabeled data. Traditionally, learning has been studied either in the unsupervised paradigm (e.g., clustering, outlier detection) where all the data are unlabeled, or in the supervised paradigm (e.g., classification, regression) where all the data are labeled. The goal of semi-supervised learning is to understand how combining labeled and unlabeled data may change the learning behavior, and design algorithms that take advantage of such a combination. Semi-supervised learning is of great interest in machine learning and data mining because it can use readily available unlabeled data

to improve supervised learning tasks when the labeled data are scarce or expensive. Semi-supervised learning also shows potential as a quantitative tool to understand human category learning, where most of the input is self-evidently unlabeled. In this introductory book, we present some popular semi-supervised learning models, including self-training, mixture models, co-training and multiview learning, graph-based methods, and semi-supervised support vector machines. For each model, we discuss its basic mathematical formulation. The success of semi-supervised learning depends critically on some underlying assumptions. We emphasize the assumptions made by each model and give counterexamples when appropriate to demonstrate the limitations of the different models. In addition, we discuss semi-supervised learning for cognitive psychology. Finally, we give a computational learning theoretic perspective on semi-supervised learning, and we conclude the book with a brief discussion of open questions in the field. Table of Contents: Introduction to Statistical Machine Learning / Overview of Semi-Supervised Learning / Mixture Models and EM / Co-Training / Graph-Based Semi-Supervised Learning / Semi-Supervised Support Vector Machines / Human Semi-Supervised Learning / Theory and Outlook

This book is a brief introduction to negative quantum channels, i.e., linear, trace-preserving (and consistent) quantum maps that are not completely positive. The flat and sharp operators are introduced and explained. Complete positivity is presented as a mathematical property, but it is argued that complete positivity is not a physical requirement of all quantum operations.

Negativity, a measure of the lack of complete positivity, is proposed as a tool for empirically testing complete positivity assumptions. Table of Contents: Preface / Acknowledgments / Introduction and Definition of Terms / Tomography / Non-Positive Reduced Dynamics / Complete Positivity / Physical Motivation of Complete Positivity / Measures of Complete Positivity / Negative Channels / Negative Climates with Diagonal Composite Dynamics / Rabi Channels / Physical Motivations for Sharp Operations / Negative Qubit Channel Examples with Multi-Qubit Baths / Proposed Experimental Demonstration of Negativity / Implications of Negative Channels / Uses for Negative Channels / Conclusions / Bibliography / Author's Biography

Underwater vehicles and underwater moorings are increasing in tactical importance. As such, it is critical to have a robust and secure communication system connecting underwater vehicles on a long seaborne mission and a ground station. As a matter of fact, the deployment of efficient communication links with underwater vehicles is one of the greatest technological challenges presently confronted by the world's naval forces.To circumvent most of the limitations involved in the use of RF or acoustic channels for perfectly secure communications with underwater vehicles, it is worth considering the feasibility of an optical channel to facilitate a two-way satellite communication link secured via perfectly secure ciphers enabled by a quantum key distribution protocol.This book offers a concise review of underwater communications systems. Our approach is pedagogical, making a strong emphasis on the physics behind the attenuating properties of the oceanic environment and the propagation of electromagnetic signals in the ELF, VLF, and optical bands. We assume the reader is familiar with the basic principles of classical electrodynamics and optics.The system design,

components, and noise analysis of an underwater optical communications device are discussed in detail. Furthermore, we offer simulations of the performance of the communication system for different types of ocean waters. Our final conclusion is that it appears to be feasible to design and build underwater communications using optical classical and quantum channels secured with quantum key distribution protocols.

Technical and Military Imperatives: A Radar History of World War II is a coherent account of the history of radar in the second World War. Although many books have been written on the early days of radar and its role in the war, this book is by far the most comprehensive, covering ground, air, and sea operations in all theatres of World War II. The author manages to synthesize a vast amount of material in a highly readable, informative, and enjoyable way. Of special interest is extensive new material about the development and use of radar by Germany, Japan, Russia, and Great British. The story is told without undue technical complexity, so that the book is accessible to specialists and nonspecialists alike.

Provides a classical physics-based explanation of quantum physics, including a description of photon creation and annihilation, and successful working models of both photons and electrons. This book shows classical field theory to describe atomic scale events, including photon emission and annihilation.

'Sidney Coleman was the master teacher of quantum field theory. All of us who knew him became his students and disciples. Sidney’s legendary course remains fresh and bracing, because he chose his topics with a sure feel for the essential, and treated them with elegant economy.' Frank WilczekNobel Laureate in Physics 2004 Sidney Coleman was a physicist's physicist. He is largely unknown outside of the theoretical physics community, and known only

by reputation to the younger generation. He was an unusually effective teacher, famed for his wit, his insight and his encyclopedic knowledge of the field to which he made many important contributions. There are many first-rate quantum field theory books (the venerable Bjorken and Drell, the more modern Itzykson and Zuber, the now-standard Peskin and Schroeder, and the recent Zee), but the immediacy of Prof. Coleman's approach and his ability to present an argument simply without sacrificing rigor makes his book easy to read and ideal for the student. Part of the motivation in producing this book is to pass on the work of this outstanding physicist to later generations, a record of his teaching that he was too busy to leave himself.
Containing contributions from leading researchers in this field, this book provides a complete overview of this field from the frontiers of theoretical physics research for graduate students and researchers. It introduces the most current approaches to this problem, and reviews their main achievements.
Takes students and researchers on a tour through some of the deepest ideas of maths, computer science and physics.
Ever since 1911, the Solvay Conferences have shaped modern physics. The 23rd edition, chaired by 2004 Nobel Laureate David Gross, did not break with that tradition. It gathered most of the leading figures working on the central problem of reconciling Einstein's theory of gravity with quantum mechanics.These proceedings give a broad overview with unique insight into the most fundamental issues raised by this challenge for 21st century physics, by distinguished renowned scientists. The contributions cover: the status of quantum mechanics, spacetime singularities and breakdown of classical space and time, mathematical structures underlying the most promising attempts under current development, spacetime as an emergent concept,

as well as cosmology and the cosmological constant puzzle. A historical overview of the Solvay conferences by historian of sciences Peter Galison opens the volume.In the Solvay tradition, the volume also includes the discussions among the participants ? many of which were quite lively and illustrate dramatically divergent points of view ? carefully edited and reproduced in full.

The Quantum Age cuts through the hype to demystify quantum technologies, their development paths, and the policy issues they raise.

This book provides a comprehensive introduction to quantum image processing, which focuses on extending conventional image processing tasks to the quantum computing frameworks. It summarizes the available quantum image representations and their operations, reviews the possible quantum image applications and their implementation, and discusses the open questions and future development trends. It offers a valuable reference resource for graduate students and researchers interested in this emerging interdisciplinary field.

In this text we present a technical overview of the emerging field of quantum computation along with new research results by the authors. What distinguishes our presentation from that of others is our focus on the relationship between quantum computation and computer science. Specifically, our emphasis is on the computational model of quantum computingrather than on the engineering issues associated with its physical implementation. We adopt this approach for the same reason that a book on computer programming doesn't cover the theory and physical realization of semiconductors. Another distinguishing feature of this text is our detailed discussion of the circuit complexity of quantum algorithms. To the extent possible we have presented the material in a form that is accessible to the computer scientist, but in many cases

we retain the conventional physics notation so that the reader will also be able to consult the relevant quantum computing literature. Although we expect the reader to have a solid understanding of linear algebra, we do not assume a background in physics. This text is based on lectures given as short courses and invited presentations around the world, and it has been used as the primary text for a graduatecourse at George Mason University. In all these cases our challenge has been the same: how to present to a generalaudience a concise introduction to the algorithmic structure and applications of quantum computing on an extremely short period of time. The feedback from these courses and presentations has greatly aided in making our exposition of challenging concepts more accessible to a general audience. Table of Contents: Introduction / The Algorithmic Structure of Quantum Computing / Advantages and Limitations of Quantum Computing / Amplitude Amplification / Case Study: Computational Geometry / The Quantum Fourier Transform / Case Study: The Hidden Subgroup / Circuit Complexity Analysis of Quantum Algorithms / Conclusions / Bibliography

This book focuses on the gradual formation of the concept of ‘light quanta’ or ‘photons’, as they have usually been called in English since 1926. The great number of synonyms that have been used by physicists to denote this concept indicates that there are many different mental models of what ‘light quanta’ are: simply finite, ‘quantized packages of energy’ or ‘bullets of light’? ‘Atoms of light’ or ‘molecules of light’? ‘Light corpuscles’ or ‘quantized waves’? Singularities of the field or spatially extended structures able to interfere? ‘Photons’ in G.N. Lewis’s sense, or as defined by QED, i.e. virtual exchange particles transmitting the electromagnetic force? The term ‘light quantum’ made its first appearance in Albert Einstein’s 1905 paper on a “heuristic point of view” to cope with the photoelectric effect and other forms

of interaction of light and matter, but the mental model associated with it has a rich history both before and after 1905. Some of its semantic layers go as far back as Newton and Kepler, some are only fully expressed several decades later, while others initially increased in importance then diminished and finally vanished. In conjunction with these various terms, several mental models of light quanta were developed—six of them are explored more closely in this book. It discusses two historiographic approaches to the problem of concept formation: (a) the author's own model of conceptual development as a series of semantic accretions and (b) Mark Turner's model of 'conceptual blending'. Both of these models are shown to be useful and should be explored further. This is the first historiographically sophisticated history of the fully fledged concept and all of its twelve semantic layers. It systematically combines the history of science with the history of terms and a philosophically inspired history of ideas in conjunction with insights from cognitive science.

Synthetic Aperture Radar Automatic Detection Algorithms (SARADA) for Oil Spills conveys the pivotal tool required to fully comprehend the advanced algorithms in radar monitoring and detection of oil spills, particularly quantum computing and algorithms as a keystone to comprehending theories and algorithms behind radar imaging and detection of marine pollution. Bridging the gap between modern quantum mechanics and computing detection algorithms of oil spills, this book contains precise theories and techniques for automatic identification of oil spills from SAR measurements. Based on modern quantum physics, the book also includes the novel theory on radar imaging mechanism of oil spills. With the use of precise quantum simulation of trajectory movements of oil spills using a sequence of radar images, this book demonstrates the use of SARADA for contamination by oil spills as a

promising novel technique. Key Features: Introduces basic concepts of a radar remote sensing. Fills a gap in the knowledge base of quantum theory and microwave remote sensing. Discusses the important aspects of oil spill imaging in radar data in relation to the quantum theory. Provides recent developments and progresses of automatic detection algorithms of oil spill from radar data. Presents 2-D oil spill radar data in 4-D images.

Quantum RadarMorgan & Claypool Publishers

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