[Books] The Math Of Neural Networks

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The Math of Neural Networks-Michael Taylor 2017-10-04 There are many reasons why neural networks fascinate us and have captivated headlines in recent years. They make web searches better, organize photos, and are even used in speech translation. Heck, they can even generate encryption. At the same time, they are also mysterious and mind-bending: how exactly do they accomplish these things ? What goes on inside a neural network?On a high level, a network learns just like we do, through trial and error. This is true regardless if the network is supervised, unsupervised, or semi-supervised. Once we dig a bit deeper though, we discover that a handful of mathematical functions play a major role in the trial and error process. It also becomes clear that a grasp of the underlying mathematics helps clarify how a network learns. In the following chapters we will unpack the mathematics that drive a neural network. To do this, we will use a feedforward network as our model and follow input as it moves through the network.

Discrete Mathematics of Neural Networks-Martin Anthony 2001-01-01 This concise, readable book provides a sampling of the very large, active, and expanding field of artificial neural network theory. It considers select areas of discrete mathematics linking combinatorics and the theory of the simplest types of artificial neural networks. Neural networks have emerged as a key technology in many fields of application, and an understanding of the theories concerning what such systems can and cannot do is essential. Some classical results are presented with accessible proofs, together with some more recent perspectives, such as those obtained by considering decision lists. In addition,

probabilistic models of neural network learning are discussed. Graph theory, some partially ordered set theory, computational complexity, and discrete probability are among the mathematical topics involved. Pointers to further reading and an extensive bibliography make this book a good starting point for research in discrete mathematics and neural networks.

Mathematics of Neural Networks-Stephen W. Ellacott 2012-12-06 This volume of research papers comprises the proceedings of the first International Conference on Mathematics of Neural Networks and Applications (MANNA), which was held at Lady Margaret Hall, Oxford from July 3rd to 7th, 1995 and attended by 116 people. The meeting was strongly supported and, in addition to a stimulating academic programme, it featured a delightful venue, excellent food and accommo dation, a full social programme and fine weather - all of which made for a very enjoyable week. This was the first meeting with this title and it was run under the auspices of the Universities of Huddersfield and Brighton, with sponsorship from the US Air Force (European Office of Aerospace Research and Development) and the London Math ematical Society. This enabled a very interesting and wide-ranging conference pro gramme to be offered. We sincerely thank all these organisations, USAF-EOARD, LMS, and Universities of Huddersfield and Brighton for their invaluable support. The conference organisers were John Mason (Huddersfield) and Steve Ellacott (Brighton), supported by a programme committee consisting of Nigel Allinson (UMIST), Norman Biggs (London School of Economics), Chris Bishop (Aston), David Lowe (Aston), Patrick Parks (Oxford), John Taylor (King's College, Lon don) and Kevin Warwick (Reading). The local organiser from Huddersfield was Ros Hawkins, who took responsibility for

much of the administration with great efficiency and energy. The Lady Margaret Hall organisation was led by their bursar, Jeanette Griffiths, who ensured that the week was very smoothly run.

Deep Neural Networks in a Mathematical Framework-Anthony L. Caterini 2018-03-22 This SpringerBrief describes how to build a rigorous end-to-end mathematical framework for deep neural networks. The authors provide tools to represent and describe neural networks, casting previous results in the field in a more natural light. In particular, the authors derive gradient descent algorithms in a unified way for several neural network structures, including multilayer perceptrons, convolutional neural networks, deep autoencoders and recurrent neural networks. Furthermore, the authors developed framework is both more concise and mathematically intuitive than previous representations of neural networks. This SpringerBrief is one step towards unlocking the black box of Deep Learning. The authors believe that this framework will help catalyze further discoveries regarding the mathematical properties of neural networks.This SpringerBrief is accessible not only to researchers, professionals and students working and studying in the field of deep learning, but also to those outside of the neutral network community.

An Introduction to Neural Networks-Kevin Gurney 2003-12-16 Though mathematical ideas underpin the study of neural networks, the author presents the fundamentals without the full mathematical apparatus. All aspects of the field are tackled, including artificial neurons as models of their real counterparts; the geometry of network action in pattern space; gradient descent methods, including back-propagation; associative memory and Hopfield nets; and self-organization and feature maps. The traditionally difficult topic of adaptive resonance theory is clarified within a hierarchical description of its operation. The book also includes several real-world examples to provide a concrete focus. This should enhance its appeal to those involved in the design, construction and management of networks in commercial environments and who wish to improve their understanding of network simulator packages. As a comprehensive and highly accessible introduction to one of the most important topics in cognitive and computer science, this volume should interest a wide range of readers, both students and professionals, in cognitive science, psychology, computer science and electrical engineering.

Deep Neural Networks in a Mathematical Framework-Anthony L. Caterini 2018-04-03 This SpringerBrief describes how to build a rigorous end-to-end mathematical framework for deep neural networks. The authors provide tools to represent and describe neural networks, casting previous results in the field in a more natural light. In particular, the authors derive gradient descent algorithms in a unified way for several neural network structures, including multilayer perceptrons, convolutional neural networks, deep autoencoders and recurrent neural networks. Furthermore, the authors developed framework is both more concise and mathematically intuitive than previous representations of neural networks. This SpringerBrief is one step towards unlocking the black box of Deep Learning. The authors believe that this framework will help catalyze further discoveries regarding the mathematical properties of neural networks.This SpringerBrief is accessible not only to researchers, professionals and students working and studying in the field of deep learning, but also to those outside of the neutral network community.

Make Your Own Neural Network: An In-Depth Visual Introduction for Beginners-Michael Taylor 2017-10-04 A step-by-step visual journey through the mathematics of neural networks, and making your own using Python and Tensorflow. What you will gain from this book: * A deep understanding of how a Neural Network works. * How to build a Neural Network from scratch using Python. Who this book is for: * Beginners who want to fully understand how networks work, and learn to build two step-by-step examples in Python. * Programmers who need an easy to read, but solid refresher, on the math of neural networks. What's Inside - 'Make Your Own Neural Network: An Indepth Visual Introduction For Beginners' What Is a Neural Network? Neural networks have made a gigantic comeback in the last few decades and you likely make use of them everyday without realizing it, but what exactly is a neural network? What is it used for and how does it fit within the broader arena of machine learning? we gently explore these topics so that we can be prepared to dive deep further on. To start, we'll begin with a high-

level overview of machine learning and then drill down into the specifics of a neural network. The Math of Neural Networks On a high level, a network learns just like we do, through trial and error. This is true regardless if the network is supervised, unsupervised, or semi-supervised. Once we dig a bit deeper though, we discover that a handful of mathematical functions play a major role in the trial and error process. It also becomes clear that a grasp of the underlying mathematics helps clarify how a network learns. * Forward Propagation * Calculating The Total Error * Calculating The Gradients * Updating The Weights Make Your Own Artificial Neural Network: Hands on Example You will learn to build a simple neural network using all the concepts and functions we learned in the previous few chapters. Our example will be basic but hopefully very intuitive. Many examples available online are either hopelessly abstract or make use of the same data sets, which can be repetitive. Our goal is to be crystal clear and engaging, but with a touch of fun and uniqueness. This section contains the following eight chapters. Building Neural Networks in Python There are many ways to build a neural network and lots of tools to get the job done. This is fantastic, but it can also be overwhelming when you start, because there are so many tools to choose from. We are going to take a look at what tools are needed and help you nail down the essentials. To build a neural network Tensorflow and Neural Networks There is no single way to build a feedforward neural network with Python, and that is especially true if you throw Tensorflow into the mix. However, there is a general framework that exists that can be divided into five steps and grouped into two parts. We are going to briefly explore these five steps so that we are prepared to use them to build a network later on. Ready? Let's begin. Neural Network: Distinguish Handwriting We are going to dig deep with Tensorflow and build a neural network that can distinguish between handwritten numbers. We'll use the same 5 steps we covered in the high-level overview, and we are going to take time exploring each line of code. Neural Network: Classify Images 10 minutes. That's all it takes to build an image classifier thanks to Google! We will provide a high-level overview of how to classify images using a convolutional neural network (CNN) and Google's Inception V3 model. Once finished, you will be able to tweak this code to classify any type of image sets! Cats, bats, super heroes - the sky's the limit.

Neural Networks Without the Math-Alan French 2018-04-30 This is a book on neural networks for non-technical readers. Nowadays, when AI and neural networks influence and control the lives of all, everyone needs to have a very basic idea of what neural networks are and how they work. This book explains neural networks in sufficient depth for a non-CS university course.

Make Your Own Neural Network-Tariq Rashid 2016-03-31 A step-by-step gentle journey through the mathematics of neural networks, and making your own using the Python computer language. Neural networks are a key element of deep learning and artificial intelligence, which today is capable of some truly impressive feats. Yet too few really understand how neural networks actually work. This guide will take you on a fun and unhurried journey, starting from very simple ideas, and gradually building up an understanding of how neural networks work. You won't need any mathematics beyond secondary school, and an accessible introduction to calculus is also included. The ambition of this guide is to make neural networks as accessible as possible to as many readers as possible - there are enough texts for advanced readers already! You'll learn to code in Python and make your own neural network, teaching it to recognise human handwritten numbers, and performing as well as professionally developed networks. Part 1 is about ideas. We introduce the mathematical ideas underlying the neural networks, gently with lots of illustrations and examples. Part 2 is practical. We introduce the popular and easy to learn Python programming language, and gradually builds up a neural network which can learn to recognise human handwritten numbers, easily getting it to perform as well as networks made by professionals. Part 3 extends these ideas further. We push the performance of our neural network to an industry leading 98% using only simple ideas and code, test the network on your own handwriting, take a privileged peek inside the mysterious mind of a neural network, and even get it all working on a Raspberry Pi. All the code in this has been tested to work on a Raspberry Pi Zero.

Applications of Mathematics in Models, Artificial Neural Networks and Arts-Vittorio

Capecchi 2010-08-03 The book shows a very original organization addressing in a non traditional way, but with a systematic approach, to who has an interest in using mathematics in the social sciences. The book is divided in four parts: (a) a historical part, written by Vittorio Capecchi which helps us understand the changes in the relationship between mathematics and sociology by analyzing the mathematical models of Paul F. Lazarsfeld, the model of simulation and artificial societies, models of artificial neural network and considering all the changes in scientific paradigms considered; (b) a part coordinated by Pier Luigi Contucci on mathematical models that consider the relationship between the mathematical models that come from physics and linguistics to arrive at the study of society and those which are born within sociology and economics; (c) a part coordinated by Massimo Buscema analyzing models of artificial neural networks; (d) a part coordinated by Bruno D'Amore which considers the relationship between mathematics and art. The title of the book "Mathematics and Society" was chosen because the mathematical applications exposed in the book allow you to address two major issues: (a) the general theme of technological innovation and quality of life (among the essays are on display mathematical applications to the problems of combating pollution and crime, applications to mathematical problems of immigration, mathematical applications to the problems of medical diagnosis, etc.) (b) the general theme of technical innovation and creativity, for example the art and mathematics section which connects to the theme of creative cities. The book is very original because it is not addressed only to those who are passionate about mathematical applications in social science but also to those who, in different societies, are: (a) involved in technological innovation to improve the quality of life; (b) involved in the wider distribution of technological innovation in different areas of creativity (as in the project "Creative Cities Network" of UNESCO).

Hands-On Mathematics for Deep Learning-Jay Dawani 2020-06-12 A comprehensive guide to getting well-versed with the mathematical techniques for building modern deep learning architectures Key Features Understand linear algebra, calculus, gradient algorithms, and other concepts essential for training deep neural networks Learn the mathematical concepts needed to understand how deep learning models function Use deep learning for solving problems related to vision, image, text, and sequence applications Book Description Most programmers and data scientists struggle with mathematics, having either overlooked or forgotten core mathematical concepts. This book uses Python libraries to help you understand the math required to build deep learning (DL) models. You'll begin by learning about core mathematical and modern computational techniques used to design and implement DL algorithms. This book will cover essential topics, such as linear algebra, eigenvalues and eigenvectors, the singular value decomposition concept, and gradient algorithms, to help you understand how to train deep neural networks. Later chapters focus on important neural networks, such as the linear neural network and multilayer perceptrons, with a primary focus on helping you learn how each model works. As you advance, you will delve into the math used for regularization, multi-layered DL, forward propagation, optimization, and backpropagation techniques to understand what it takes to build full-fledged DL models. Finally, you'll explore CNN, recurrent neural network (RNN), and GAN models and their application. By the end of this book, you'll have built a strong foundation in neural networks and DL mathematical concepts, which will help you to confidently research and build custom models in DL. What you will learn Understand the key mathematical concepts for building neural network models Discover core multivariable calculus concepts Improve the performance of deep learning models using optimization techniques Cover optimization algorithms, from basic stochastic gradient descent (SGD) to the advanced Adam optimizer Understand computational graphs and their importance in DL Explore the backpropagation algorithm to reduce output error Cover DL algorithms such as convolutional neural networks (CNNs), sequence models, and generative adversarial networks (GANs) Who this book is for This book is for data scientists, machine learning developers, aspiring deep learning developers, or anyone who wants to understand the foundation of deep learning by learning the math behind it. Working knowledge of the Python programming language and machine learning basics is required.

Artificial Neural Networks-Kevin L. Priddy 2005 This tutorial text provides the reader with an understanding of artificial neural networks

(ANNs), and their application, beginning with the biological systems which inspired them, through the learning methods that have been developed, and the data collection processes, to the many ways ANNs are being used today. The material is presented with a minimum of math (although the mathematical details are included in the appendices for interested readers), and with a maximum of hands-on experience. All specialized terms are included in a glossary. The result is a highly readable text that will teach the engineer the guiding principles necessary to use and apply artificial neural networks.

Neural Networks-Raul Rojas 2013-06-29 Neural networks are a computing paradigm that is finding increasing attention among computer scientists. In this book, theoretical laws and models previously scattered in the literature are brought together into a general theory of artificial neural nets. Always with a view to biology and starting with the simplest nets, it is shown how the properties of models change when more general computing elements and net topologies are introduced. Each chapter contains examples, numerous illustrations, and a bibliography. The book is aimed at readers who seek an overview of the field or who wish to deepen their knowledge. It is suitable as a basis for university courses in neurocomputing.

Neural Networks and Animal Behavior-Magnus Enquist 2005-09-04 How can we make better sense of animal behavior by using what we know about the brain? This is the first book that attempts to answer this important question by applying neural network theory. Scientists create Artificial Neural Networks (ANNs) to make models of the brain. These networks mimic the architecture of a nervous system by connecting elementary neuron-like units into networks in which they stimulate or inhibit each other's activity in much the same way neurons do. This book shows how scientists can employ ANNs to analyze animal behavior, explore the general principles of the nervous systems, and test potential generalizations among species. The authors focus on simple neural networks to show how ANNs can be investigated by math and by computers. They demonstrate intuitive concepts that make the operation of neural networks more accessible to nonspecialists. The first chapter introduces various approaches to animal behavior and provides an informal introduction

to neural networks, their history, and their potential advantages. The second chapter reviews artificial neural networks, including biological foundations, techniques, and applications. The following three chapters apply neural networks to such topics as learning and development, classical instrumental condition, and the role of genes in building brain networks. The book concludes by comparing neural networks to other approaches. It will appeal to students of animal behavior in many disciplines. It will also interest neurobiologists, cognitive scientists, and those from other fields who wish to learn more about animal behavior.

Understanding Machine Learning-Shai Shalev-Shwartz 2014-05-19 Introduces machine learning and its algorithmic paradigms, explaining the principles behind automated learning approaches and the considerations underlying their usage.

Deep Learning Architectures-Ovidiu Calin 2020-02-13 This book describes how neural networks operate from the mathematical point of view. As a result, neural networks can be interpreted both as function universal approximators and information processors. The book bridges the gap between ideas and concepts of neural networks, which are used nowadays at an intuitive level, and the precise modern mathematical language, presenting the best practices of the former and enjoying the robustness and elegance of the latter. This book can be used in a graduate course in deep learning, with the first few parts being accessible to senior undergraduates. In addition, the book will be of wide interest to machine learning researchers who are interested in a theoretical understanding of the subject.

Wavelet Neural Networks-Antonios K. Alexandridis 2014-05-05 A step-by-step introduction to modeling, training, and forecasting using wavelet networks Wavelet Neural Networks: With Applications in Financial Engineering, Chaos, and Classification presents the statistical model identification framework that is needed to successfully apply wavelet networks as well as extensive comparisons of alternate methods. Providing a concise and rigorous treatment for constructing optimal wavelet networks, the book links mathematical

aspects of wavelet network construction to statistical modeling and forecasting applications in areas such as finance, chaos, and classification. The authors ensure that readers obtain a complete understanding of model identification by providing in-depth coverage of both model selection and variable significance testing. Featuring an accessible approach with introductory coverage of the basic principles of wavelet analysis, Wavelet Neural Networks: With Applications in Financial Engineering, Chaos, and Classification also includes: • Methods that can be easily implemented or adapted by researchers, academics, and professionals in identification and modeling for complex nonlinear systems and artificial intelligence • Multiple examples and thoroughly explained procedures with numerous applications ranging from financial modeling and financial engineering, time series prediction and construction of confidence and prediction intervals, and classification and chaotic time series prediction • An extensive introduction to neural networks that begins with regression models and builds to more complex frameworks • Coverage of both the variable selection algorithm and the model selection algorithm for wavelet networks in addition to methods for constructing confidence and prediction intervals Ideal as a textbook for MBA and graduate-level courses in applied neural network modeling, artificial intelligence, advanced data analysis, time series, and forecasting in financial engineering, the book is also useful as a supplement for courses in informatics, identification and modeling for complex nonlinear systems, and computational finance. In addition, the book serves as a valuable reference for researchers and practitioners in the fields of mathematical modeling, engineering, artificial intelligence, decision science, neural networks, and finance and economics.

The Perceptron-Frank Rosenblatt 1958

Neural Network Learning-Martin Anthony 2009-08-20 This book describes recent theoretical advances in the study of artificial neural networks. It explores probabilistic models of supervised learning problems, and addresses the key statistical and computational questions. The authors also discuss the computational complexity of neural network learning, describing a variety of hardness results, and

outlining two efficient constructive learning algorithms. The book is essentially self-contained, since it introduces the necessary background material on probability, statistics, combinatorics and computational complexity; and it is intended to be accessible to researchers and graduate students in computer science, engineering, and mathematics.

Weakly Connected Neural Networks-Frank C. Hoppensteadt 2012-12-06 Devoted to local and global analysis of weakly connected systems with applications to neurosciences, this book uses bifurcation theory and canonical models as the major tools of analysis. It presents a systematic and well motivated development of both weakly connected system theory and mathematical neuroscience, addressing bifurcations in neuron and brain dynamics, synaptic organisations of the brain, and the nature of neural codes. The authors present classical results together with the most recent developments in the field, making this a useful reference for researchers and graduate students in various branches of mathematical neuroscience.

Learn Keras for Deep Neural Networks-Jojo Moolayil 2018-12-07 Learn, understand, and implement deep neural networks in a math- and programming-friendly approach using Keras and Python. The book focuses on an end-to-end approach to developing supervised learning algorithms in regression and classification with practical business-centric use-cases implemented in Keras. The overall book comprises three sections with two chapters in each section. The first section prepares you with all the necessary basics to get started in deep learning. Chapter 1 introduces you to the world of deep learning and its difference from machine learning, the choices of frameworks for deep learning, and the Keras ecosystem. You will cover a real-life business problem that can be solved by supervised learning algorithms with deep neural networks. You'll tackle one use case for regression and another for classification leveraging popular Kaggle datasets. Later, you will see an interesting and challenging part of deep learning: hyperparameter tuning; helping you further improve your models when building robust deep learning applications. Finally, you'll further hone your skills in deep learning and cover areas of active development and research in deep learning. At the end of Learn Keras for

Deep Neural Networks, you will have a thorough understanding of deep learning principles and have practical hands-on experience in developing enterprise-grade deep learning solutions in Keras. What You'll Learn Master fast-paced practical deep learning concepts with math- and programming-friendly abstractions. Design, develop, train, validate, and deploy deep neural networks using the Keras framework Use best practices for debugging and validating deep learning models Deploy and integrate deep learning as a service into a larger software service or product Extend deep learning principles into other popular frameworks Who This Book Is For Software engineers and data engineers with basic programming skills in any language and who are keen on exploring deep learning for a career move or an enterprise project.

Foundations of Machine Learning-Mehryar Mohri 2012-08-17 This graduate-level textbook introduces fundamental concepts and methods in machine learning. It describes several important modern algorithms, provides the theoretical underpinnings of these algorithms, and illustrates key aspects for their application. The authors aim to present novel theoretical tools and concepts while giving concise proofs even for relatively advanced topics. Foundations of Machine Learning fills the need for a general textbook that also offers theoretical details and an emphasis on proofs. Certain topics that are often treated with insufficient attention are discussed in more detail here; for example, entire chapters are devoted to regression, multi-class classification, and ranking. The first three chapters lay the theoretical foundation for what follows, but each remaining chapter is mostly self-contained. The appendix offers a concise probability review, a short introduction to convex optimization, tools for concentration bounds, and several basic properties of matrices and norms used in the book.The book is intended for graduate students and researchers in machine learning, statistics, and related areas; it can be used either as a textbook or as a reference text for a research seminar.

Neural Networks-Satish Kumar 2004

Neural Networks and Statistical Learning-Ke-Lin Du 2019-09-12 This book provides a broad

yet detailed introduction to neural networks and machine learning in a statistical framework. A single, comprehensive resource for study and further research, it explores the major popular neural network models and statistical learning approaches with examples and exercises and allows readers to gain a practical working understanding of the content. This updated new edition presents recently published results and includes six new chapters that correspond to the recent advances in computational learning theory, sparse coding, deep learning, big data and cloud computing. Each chapter features state-of-the-art descriptions and significant research findings. The topics covered include: • multilayer perceptron; • the Hopfield network; • associative memory models;• clustering models and algorithms; • t he radial basis function network; • recurrent neural networks; • nonnegative matrix factorization; • independent component analysis; •probabilistic and Bayesian networks; and • fuzzy sets and logic. Focusing on the prominent accomplishments and their practical aspects, this book provides academic and technical staff, as well as graduate students and researchers with a solid foundation and comprehensive reference on the fields of neural networks, pattern recognition, signal processing, and machine learning.

Applied Artificial Neural Networks-Christian Dawson 2018-09-27 This book is a printed edition of the Special Issue "Applied Artificial Neural Network" that was published in Applied Sciences

The Roots of Backpropagation-Paul John Werbos 1994-02-11 Now, for the first time, publication of the landmark work inbackpropagation! Scientists, engineers, statisticians, operationsresearchers, and other investigators involved in neural networkshave long sought direct access to Paul Werbos's groundbreaking,much-cited 1974 Harvard doctoral thesis, The Roots ofBackpropagation, which laid the foundation of backpropagation. Now,with the publication of its full text, these practitioners can gostraight to the original material and gain a deeper, practicalunderstanding of this unique mathematical approach to socialstudies and related fields. In addition, Werbos has provided threemore recent research papers, which were inspired by his originalwork, and a new guide to the field. Originally written for readerswho

lacked any knowledge of neural nets, The Roots ofBackpropagation firmly established both its historical andcontinuing significance as it: * Demonstrates the ongoing value and new potential ofbackpropagation * Creates a wealth of sound mathematical tools useful acrossdisciplines * Sets the stage for the emerging area of fast automaticdifferentiation * Describes new designs for forecasting and control which exploitbackpropagation * Unifies concepts from Freud, Jung, biologists, and others into anew mathematical picture of the human mind and how it works * Certifies the viability of Deutsch's model of nationalism as apredictive tool--as well as the utility of extensions of thiscentral paradigm "What a delight it was to see Paul Werbos rediscover Freud'sversion of 'back-propagation.' Freud was adamant (in The Projectfor a Scientific Psychology) that selective learning could onlytake place if the presynaptic neuron was as influenced as is thepostsynaptic neuron during excitation. Such activation of bothsides of the contact barrier (Freud's name for the synapse) wasaccomplished by reducing synaptic resistance by the absorption of'energy' at the synaptic membranes. Not bad for 1895! But Werbos1993 is even better." --Karl H. Pribram Professor Emeritus,Stanford University

Introduction to the Math of Neural Networks-Jeff Heaton 2007

An Introduction to Neural Networks-James A. Anderson 1995 An Introduction to Neural Networks falls into a new ecological niche for texts. Based on notes that have been class-tested for more than a decade, it is aimed at cognitive science and neuroscience students who need to understand brain function in terms of computational modeling, and at engineers who want to go beyond formal algorithms to applications and computing strategies. It is the only current text to approach networks from a broad neuroscience and cognitive science perspective, with an emphasis on the biology and psychology behind the assumptions of the models, as well as on what the models might be used for. It describes the mathematical and computational tools needed and provides an account of the author's own ideas. Students learn how to teach arithmetic to a neural network and get a short course on linear associative memory and adaptive maps. They are introduced to the author's brain-state-in-a-box (BSB) model and are

provided with some of the neurobiological background necessary for a firm grasp of the general subject. The field now known as neural networks has split in recent years into two major groups, mirrored in the texts that are currently available: the engineers who are primarily interested in practical applications of the new adaptive, parallel computing technology, and the cognitive scientists and neuroscientists who are interested in scientific applications. As the gap between these two groups widens, Anderson notes that the academics have tended to drift off into irrelevant, often excessively abstract research while the engineers have lost contact with the source of ideas in the field. Neuroscience, he points out, provides a rich and valuable source of ideas about data representation and setting up the data representation is the major part of neural network programming. Both cognitive science and neuroscience give insights into how this can be done effectively: cognitive science suggests what to compute and neuroscience suggests how to compute it.

Neural Networks in Finance-Paul D. McNelis 2005 This book explores the intuitive appeal of neural networks and the genetic algorithm in finance. It demonstrates how neural networks used in combination with evolutionary computation outperform classical econometric methods for accuracy in forecasting, classification and dimensionality reduction. McNelis utilizes a variety of examples, from forecasting automobile production and corporate bond spread, to inflation and deflation processes in Hong Kong and Japan, to credit card default in Germany to bank failures in Texas, to cap-floor volatilities in New York and Hong Kong. * Offers a balanced, critical review of the neural network methods and genetic algorithms used in finance * Includes numerous examples and applications * Numerical illustrations use MATLAB code and the book is accompanied by a website

Mathematics for Machine Learning-Marc Peter Deisenroth 2020-04-23 The fundamental mathematical tools needed to understand machine learning include linear algebra, analytic geometry, matrix decompositions, vector calculus, optimization, probability and statistics. These topics are traditionally taught in disparate courses, making it hard for data science or computer science students, or professionals, to

efficiently learn the mathematics. This self-contained textbook bridges the gap between mathematical and machine learning texts, introducing the mathematical concepts with a minimum of prerequisites. It uses these concepts to derive four central machine learning methods: linear regression, principal component analysis, Gaussian mixture models and support vector machines. For students and others with a mathematical background, these derivations provide a starting point to machine learning texts. For those learning the mathematics for the first time, the methods help build intuition and practical experience with applying mathematical concepts. Every chapter includes worked examples and exercises to test understanding. Programming tutorials are offered on the book's web site.

Complex-Valued Neural Networks with Multi-Valued Neurons-Igor Aizenberg 2011-06-24 Complex-Valued Neural Networks have higher functionality, learn faster and generalize better than their real-valued counterparts. This book is devoted to the Multi-Valued Neuron (MVN) and MVN-based neural networks. It contains a comprehensive observation of MVN theory, its learning, and applications. MVN is a complex-valued neuron whose inputs and output are located on the unit circle. Its activation function is a function only of argument (phase) of the weighted sum. MVN derivative-free learning is based on the error-correction rule. A single MVN can learn those input/output mappings that are non-linearly separable in the real domain. Such classical non-linearly separable problems as XOR and Parity n are the simplest that can be learned by a single MVN. Another important advantage of MVN is a proper treatment of the phase information. These properties of MVN become even more remarkable when this neuron is used as a basic one in neural networks. The Multilayer Neural Network based on Multi-Valued Neurons (MLMVN) is an MVN-based feedforward neural network. Its backpropagation learning algorithm is derivative-free and based on the error-correction rule. It does not suffer from the local minima phenomenon. MLMVN outperforms many other machine learning techniques in terms of learning speed, network complexity and generalization capability when solving both benchmark and real-world classification and prediction problems. Another interesting application of MVN is its use as a basic neuron in

multi-state associative memories. The book is addressed to those readers who develop theoretical fundamentals of neural networks and use neural networks for solving various real-world problems. It should also be very suitable for Ph.D. and graduate students pursuing their degrees in computational intelligence.

Zhang Neural Networks and Neural-Dynamic Method-Yunong Zhang 2011 The real-time solution to a mathematical problem arises in numerous fields of science, engineering, and business. It is usually an essential part of many solutions, e.g., matrix/vector computation, optimization, control theory, kinematics, signal processing, and pattern recognition. In recent years, due to the in-depth research on neural networks, numerous recurrent neural networks (RNN) based on the gradient-based method have been developed and investigated. Particularly, some simple neural networks were proposed to solve linear programming problems in real time and implemented on analog circuits. In this book, ZNN, ZD or ZND theory formalizes these problems and solutions in the time-varying context and provides compact models that could solve those dynamic problems.

Neural Networks and Deep Learning-Charu C. Aggarwal 2018-08-25 This book covers both classical and modern models in deep learning. The primary focus is on the theory and algorithms of deep learning. The theory and algorithms of neural networks are particularly important for understanding important concepts, so that one can understand the important design concepts of neural architectures in different applications. Why do neural networks work? When do they work better than off-the-shelf machine-learning models? When is depth useful? Why is training neural networks so hard? What are the pitfalls? The book is also rich in discussing different applications in order to give the practitioner a flavor of how neural architectures are designed for different types of problems. Applications associated with many different areas like recommender systems, machine translation, image captioning, image classification, reinforcement-learning based gaming, and text analytics are covered. The chapters of this book span three categories: The basics of neural networks: Many traditional machine learning models can be understood as special cases of neural networks. An emphasis is

placed in the first two chapters on understanding the relationship between traditional machine learning and neural networks. Support vector machines, linear/logistic regression, singular value decomposition, matrix factorization, and recommender systems are shown to be special cases of neural networks. These methods are studied together with recent feature engineering methods like word2vec. Fundamentals of neural networks: A detailed discussion of training and regularization is provided in Chapters 3 and 4. Chapters 5 and 6 present radial-basis function (RBF) networks and restricted Boltzmann machines. Advanced topics in neural networks: Chapters 7 and 8 discuss recurrent neural networks and convolutional neural networks. Several advanced topics like deep reinforcement learning, neural Turing machines, Kohonen self-organizing maps, and generative adversarial networks are introduced in Chapters 9 and 10. The book is written for graduate students, researchers, and practitioners. Numerous exercises are available along with a solution manual to aid in classroom teaching. Where possible, an application-centric view is highlighted in order to provide an understanding of the practical uses of each class of techniques.

Fundamentals of Artificial Neural Networks-Mohamad H. Hassoun 1995 A systematic account of artificial neural network paradigms that identifies fundamental concepts and major methodologies. Important results are integrated into the text in order to explain a wide range of existing empirical observations and commonly used heuristics.

Linear Algebra and Learning from Data-Gilbert Strang 2019-01-31 Linear algebra and the foundations of deep learning, together at last! From Professor Gilbert Strang, acclaimed author of Introduction to Linear Algebra, comes Linear Algebra and Learning from Data, the first textbook that teaches linear algebra together with deep learning and neural nets. This readable yet rigorous textbook contains a complete course in the linear algebra and related mathematics that students need to know to get to grips with learning from data. Included are: the four fundamental subspaces, singular value decompositions, special matrices, large matrix computation techniques, compressed sensing, probability and statistics, optimization, the architecture of neural nets, stochastic gradient descent and backpropagation.

Neural Network Analysis, Architectures and Applications-A Browne 1997-01-01 Neural Network Analysis, Architectures and Applications discusses the main areas of neural networks, with each authoritative chapter covering the latest information from different perspectives. Divided into three parts, the book first lays the groundwork for understanding and simplifying networks. It then describes novel architectures and algorithms, including pulse-stream techniques, cellular neural networks, and multiversion neural computing. The book concludes by examining various neural network applications, such as neuron-fuzzy control systems and image compression. This final part of the book also provides a case study involving oil spill detection. This book is invaluable for students and practitioners who have a basic understanding of neural computing yet want to broaden and deepen their knowledge of the field.

Neural Network Design-Martin T. Hagan 2003

Deep Learning-Ian Goodfellow 2016-11-10 An introduction to a broad range of topics in deep learning, covering mathematical and conceptual background, deep learning techniques used in industry, and research perspectives. "Written by three experts in the field, Deep Learning is the only comprehensive book on the subject." —Elon Musk, cochair of OpenAI; cofounder and CEO of Tesla and SpaceX Deep learning is a form of machine learning that enables computers to learn from experience and understand the world in terms of a hierarchy of concepts. Because the computer gathers knowledge from experience, there is no need for a human computer operator to formally specify all the knowledge that the computer needs. The hierarchy of concepts allows the computer to learn complicated concepts by building them out of simpler ones; a graph of these hierarchies would be many layers deep. This book introduces a broad range of topics in deep learning. The text offers mathematical and conceptual background, covering relevant concepts in linear algebra, probability theory and information theory, numerical computation, and machine learning. It describes deep learning techniques used by practitioners in industry, including deep feedforward networks, regularization,

optimization algorithms, convolutional networks, sequence modeling, and practical methodology; and it surveys such applications as natural language processing, speech recognition, computer vision, online recommendation systems, bioinformatics, and videogames. Finally, the book offers research perspectives, covering such theoretical topics as linear factor models, autoencoders, representation learning, structured probabilistic models, Monte Carlo methods, the partition function, approximate inference, and deep generative models. Deep Learning can be used by undergraduate or graduate students planning careers in either industry or research, and by software engineers who want to begin using deep learning in their products or platforms. A website offers supplementary material for both readers and instructors.

Artificial Intelligence Engines-James V. Stone 2019-04 In this richly illustrated book, deep neural network learning algorithms are explained informally first, followed by detailed mathematical analyses. Written in an informal style, with a comprehensive glossary, tutorial appendices, and further readings, this is an ideal introduction to the algorithmic engines of modern artificial intelligence.

Artificial Neural Networks-Joao Luis Garcia Rosa 2016-10-19 The idea of simulating the brain was the goal of many pioneering works in Artificial Intelligence. The brain has been seen as a neural network, or a set of nodes, or neurons, connected by communication lines. Currently, there has been increasing interest in the use of neural network models. This book contains chapters on basic concepts of artificial neural networks, recent connectionist architectures and several successful applications in various fields of knowledge, from assisted speech therapy to remote sensing of hydrological parameters, from fabric defect classification to application in civil engineering. This is a current book on Artificial Neural Networks and Applications, bringing recent advances in the area to the reader interested in this always-evolving machine learning technique.