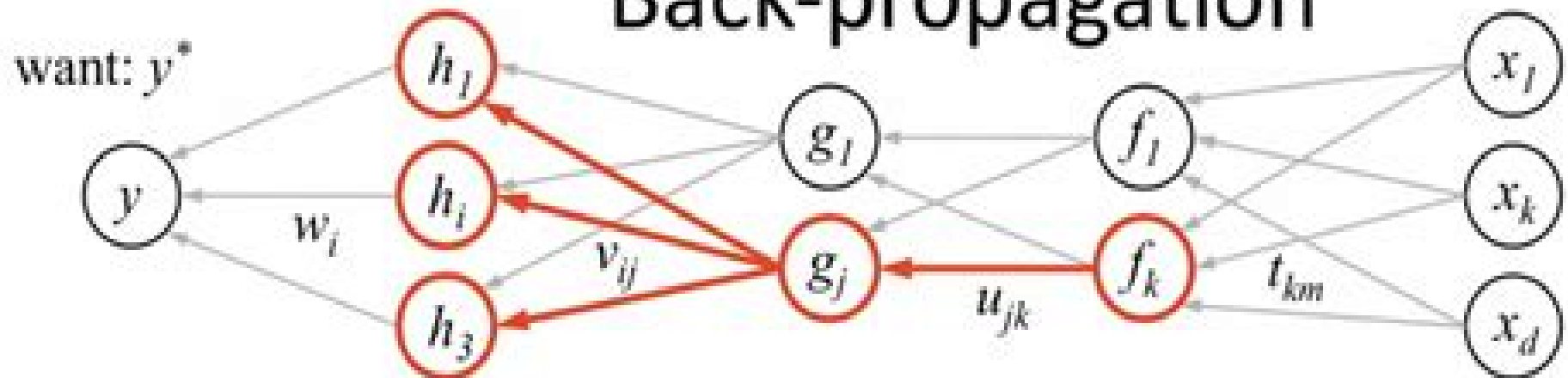


Back-propagation



1. receive new observation $x = [x_1 \dots x_d]$ and target y^*
2. **feed forward:** for each unit g_j in each layer $1 \dots L$
compute g_j based on units f_k from previous layer: $g_j = \sigma \left(u_{j0} + \sum_k u_{jk} f_k \right)$
3. get prediction y and error $(y - y^*)$
4. **back-propagate error:** for each unit g_j in each layer $L \dots 1$

(a) compute error on g_j

$$\underbrace{\frac{\partial E}{\partial g_j}}_{\text{should } g_j \text{ be higher or lower?}} = \sum_i \underbrace{\sigma'(h_i) v_{ij}}_{\text{how } h_i \text{ will change as } g_j \text{ changes}} \underbrace{\frac{\partial E}{\partial h_i}}_{\text{was } h_i \text{ too high or too low?}}$$

(b) for each u_{jk} that affects g_j

(i) compute error on u_{jk}

$$\frac{\partial E}{\partial u_{jk}} = \underbrace{\frac{\partial E}{\partial g_j}}_{\text{do we want } g_j \text{ to be higher/lower?}} \underbrace{\sigma'(g_j) f_k}_{\text{how } g_j \text{ will change if } u_{jk} \text{ is higher/lower?}}$$

(ii) update the weight

$$u_{jk} \leftarrow u_{jk} - \eta \frac{\partial E}{\partial u_{jk}}$$

Back Propagation Theory Architecture And Applications

**Pijush Dutta,Souvik Pal,Asok
Kumar,Korhan Cengiz**



Back Propagation Theory Architecture And Applications:

Neural Networks and Statistical Learning Ke-Lin Du, M. N. S. Swamy, 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, the 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.

Mathematical Perspectives on Neural Networks Paul Smolensky, Michael C. Mozer, David E. Rumelhart, 2013-05-13 Recent years have seen an explosion of new mathematical results on learning and processing in neural networks. This body of results rests on a breadth of mathematical background which even few specialists possess. In a format intermediate between a textbook and a collection of research articles, this book has been assembled to present a sample of these results and to fill in the necessary background in such areas as computability theory, computational complexity theory, the theory of analog computation, stochastic processes, dynamical systems, control theory, time series analysis, Bayesian analysis, regularization theory, information theory, computational learning theory, and mathematical statistics. Mathematical models of neural networks display an amazing richness and diversity. Neural networks can be formally modeled as computational systems, as physical or dynamical systems, and as statistical analyzers. Within each of these three broad perspectives, there are a number of particular approaches. For each of 16 particular mathematical perspectives on neural networks, the contributing authors provide introductions to the background mathematics and address questions such as: Exactly what mathematical systems are used to model neural networks from the given perspective? What formal questions about neural networks can then be addressed? What are typical results that can be obtained? What are the outstanding open problems? A distinctive feature of this volume is that for each perspective presented in one of the contributed chapters, the first editor has provided a moderately detailed summary of the formal results and the requisite mathematical concepts. These summaries are presented in four chapters that tie together the 16 contributed chapters: three develop a coherent view of the three general perspectives—computational, dynamical, and statistical—the other assembles these three perspectives into a unified overview of the neural networks field.

Backpropagation Yves Chauvin (Ph. D.), David E. Rumelhart, 1995 Composed of three sections this book presents the most popular training algorithm for neural networks backpropagation The first section presents the theory and principles behind backpropagation as seen from different perspectives such as statistics machine learning and dynamical systems The second presents a number of network architectures that may be designed to match the general concepts of Parallel Distributed Processing with backpropagation learning Finally the third section shows how these principles can be applied to a number of different fields related to the cognitive sciences including control speech recognition robotics image processing and cognitive psychology The volume is designed to provide both a solid theoretical foundation and a set of examples that show the versatility of the concepts Useful to experts in the field it should also be most helpful to students seeking to understand the basic principles of connectionist learning and to engineers wanting to add neural networks in general and backpropagation in particular to their set of problem solving methods Connectionist Models of Social Reasoning and Social Behavior Stephen John Read, Lynn C. Miller, 2014-01-14 Although neural network models have had a dramatic impact on the cognitive and brain sciences social psychology has remained largely unaffected by this intellectual explosion The first to apply neural network models to social phenomena this book includes chapters by nearly all of the individuals currently working in this area Bringing these various approaches together in one place it allows readers to appreciate the breadth of these approaches as well as the theoretical commonality of many of these models The contributors address a number of central issues in social psychology and show how these kinds of models provide insight into many classic issues Many chapters hint that this approach provides the seeds of a theoretical integration that the field has lacked Each chapter discusses an explicit connectionist model of a central problem in social psychology Since many of the contributors either use a standard architecture or provide a computer program interested readers with a little work should be able to implement their own variations of models Chapters are devoted to the following topics and models the learning and application of social categories and stereotypes causal reasoning social explanation and person perception personality and social behavior classic dissonance phenomena and belief change and the coherence of large scale belief systems Modelling Perception with Artificial Neural Networks Colin R. Tash, Graeme D. Ruxton, 2010-06-24 Studies of the evolution of animal signals and sensory behaviour have more recently shifted from considering extrinsic environmental determinants to intrinsic physiological ones The drive behind this change has been the increasing availability of neural network models With contributions from experts in the field this book provides a complete survey of artificial neural networks The book opens with two broad introductory level reviews on the themes of the book neural networks as tools to explore the nature of perceptual mechanisms and neural networks as models of perception in ecology and evolutionary biology Later chapters expand on these themes and address important methodological issues when applying artificial neural networks to study perception The final chapter provides perspective by introducing a neural processing system in a real animal The book provides the foundations for implementing

artificial neural networks for those new to the field along with identifying potential research areas for specialists *Captain Scott: Icy Deceits and Untold Realities* Krzysztof Sienicki, 2016-11-01 This expertly written book is nothing less than a daring challenge to the prevailing views of Captain Robert F Scott's journey to the South Pole and consequent disaster Borrowing from various scientific disciplines Krzysztof Sienicki lucidly argues against each of the presumed causes of Captain Scott and his companions' deaths In particular he demolishes the notions of extreme low temperatures ferocious winds and food fuel shortages as the main causes of the disaster Using neural network computer simulations he proves that the Extreme Cold Snap Never Ending Gale and food fuel scarcity never occurred By eliminating the alleged causes of the disaster the author provides data and arguments that the deaths Scott Wilson and Bowers were a matter of choice rather than fate The choice was made long before there was an actual end of food fuel and long before the end of the physical strength needed to reach delusive salvation at One Ton Depot **Data-driven Modeling for Diabetes** Vasilis Marmarelis, Georgios Mitsis, 2014-04-22

This contributed volume presents computational models of diabetes that quantify the dynamic interrelationships among key physiological variables implicated in the underlying physiology under a variety of metabolic and behavioral conditions These variables comprise for example blood glucose concentration and various hormones such as insulin glucagon epinephrine norepinephrine as well as cortisol The presented models provide a powerful diagnostic tool but may also enable treatment via long term glucose regulation in diabetics through closed loop model reference control using frequent insulin infusions which are administered by implanted programmable micro pumps This research volume aims at presenting state of the art research on this subject and demonstrating the potential applications of modeling to the diagnosis and treatment of diabetes The target audience primarily comprises research and experts in the field but the book may also be beneficial for graduate students **Advanced Intelligent Computing. Theories and Applications** De-Shuang Huang, Martin McGinnity, Laurent Heutte, Xiao-Ping Zhang, 2010-07-30 The International Conference on Intelligent Computing ICIC was formed to provide an annual forum dedicated to the emerging and challenging topics in artificial intelligence machine learning pattern recognition image processing bioinformatics and computational biology It aims to bring together researchers and practitioners from both academia and industry to share ideas problems and solutions related to the multifaceted aspects of intelligent computing ICIC 2010 held in Changsha China August 18-21 2010 constituted the 6th International Conference on Intelligent Computing It built upon the success of ICIC 2009 ICIC 2008 ICIC 2007 ICIC 2006 and ICIC 2005 that were held in Ulsan Korea Shanghai Qingdao Kunming and Hefei China respectively This year the conference concentrated mainly on the theories and methodologies as well as the emerging applications of intelligent computing Its aim was to unify the picture of contemporary intelligent computing techniques as an integral concept that highlights the trends in advanced computational intelligence and bridges theoretical research with applications Therefore the theme for this conference was Advanced Intelligent Computing Technology and Applications Papers focusing on this theme were solicited addressing theories methodologies and

applications in science and technology Artificial Intelligence for Cognitive Modeling Pijush Dutta, Souvik Pal, Asok Kumar, Korhan Cengiz, 2023-04-19 This book is written in a clear and thorough way to cover both the traditional and modern uses of artificial intelligence and soft computing. It gives an in-depth look at mathematical models, algorithms, and real-world problems that are hard to solve in MATLAB. The book is intended to provide a broad and in-depth understanding of fuzzy logic controllers, genetic algorithms, neural networks, and hybrid techniques such as ANFIS and the GA-ANN model. Features: A detailed description of basic intelligent techniques: fuzzy logic, genetic algorithm, and neural network using MATLAB. A detailed description of the hybrid intelligent technique called the adaptive fuzzy inference technique ANFIS. Formulation of the nonlinear model like analysis of ANOVA and response surface methodology. Variety of solved problems on ANOVA and RSM. Case studies of above-mentioned intelligent techniques on the different process control systems. This book can be used as a handbook and a guide for students of all engineering disciplines, operational research areas, computer applications, and for various professionals who work in the optimization area.

Proceedings of Seventh International Conference on Bio-Inspired Computing: Theories and Applications (BIC-TA 2012) Jagdish C. Bansal, Pramod Singh, Kusum Deep, Millie Pant, Atulya K. Nagar, 2012-12-04 The book is a collection of high-quality peer-reviewed research papers presented in Seventh International Conference on Bio-Inspired Computing BIC-TA 2012 held at ABV-IIITM Gwalior, India. These research papers provide the latest developments in the broad area of Computational Intelligence. The book discusses wide variety of industrial engineering and scientific applications of nature bio-inspired computing and presents invited papers from the inventors/originators of novel computational techniques.

Intelligent Computing Theories and Application De-Shuang Huang, Kang-Hyun Jo, Xiao-Long Zhang, 2018-08-08 This two-volume set LNCS 10954 and LNCS 10955 constitutes in conjunction with the volume LNAI 10956 the refereed proceedings of the 14th International Conference on Intelligent Computing ICIC 2018 held in Wuhan, China, in August 2018. The 275 full papers and 72 short papers of the three proceedings volumes were carefully reviewed and selected from 632 submissions. The papers are organized in topical sections such as: Neural Networks, Pattern Recognition, Image Processing, Intelligent Computing in Robotics, Intelligent Control and Automation, Intelligent Data Analysis and Prediction, Fuzzy Theory and Algorithms, Supervised Learning, Unsupervised Learning, Kernel Methods and Supporting Vector Machines, Knowledge Discovery and Data Mining, Natural Language Processing and Computational Linguistics, Gene Expression Array Analysis, Systems Biology, Computational Genomics, Computational Proteomics, Gene Regulation Modeling and Analysis, Protein-Protein Interaction Prediction, Next-Gen Sequencing and Metagenomics, Structure Prediction and Folding, Evolutionary Optimization for Scheduling, High-Throughput Biomedical Data Integration and Mining, Machine Learning Algorithms and Applications, Heuristic Optimization Algorithms for Real-World Applications, Evolutionary Multi-Objective Optimization and Its Applications, Swarm Evolutionary Algorithms for Scheduling and Combinatorial Optimization, Swarm Intelligence and Applications in Combinatorial Optimization, Advances

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Maglogiannis, Vassilis Plagianakos, Ioannis Vlahavas, 2012-05-26 This book constitutes the proceedings of the 7th Hellenic Conference on Artificial Intelligence SETN 2012 held in Lamia Greece in May 2012 The 47 contributions included in this volume were carefully reviewed and selected from 81 submissions They deal with emergent topics of artificial intelligence and come from the SETN main conference as well as from the following special sessions on advancing translational biological research through the incorporation of artificial intelligence methodologies artificial intelligence in bioinformatics intelligent annotation of digital content intelligent affective and natural interfaces and unified multimedia knowledge representation and processing **The Economics of Complex Spatial Systems** A. Reggiani, P. Nijkamp, 1998-05-05 This book argues that

complexity theory offers new departures for spatial economic modelling It offers a broad overview of recent advances in non linear dynamics catastrophe theory chaos theory evolutionary theory and so forth and illustrates the relevance of this new paradigm on the basis of several illustrations in the area of space economy The empirical limitations inherent in the use of non linear dynamic systems approaches are also addressed Next the application potential of biocomputing in particular neural networks and evolutionary algorithms is stressed while various empirical model results are presented The book concludes with an agenda for further research **A Field Guide to Dynamical Recurrent Networks** John F. Kolen, Stefan C. Kremer, 2001-01-15 Acquire the tools for understanding new architectures and algorithms of dynamical recurrent

networks DRNs from this valuable field guide which documents recent forays into artificial intelligence control theory and connectionism This unbiased introduction to DRNs and their application to time series problems such as classification and prediction provides a comprehensive overview of the recent explosion of leading research in this prolific field A Field Guide to Dynamical Recurrent Networks emphasizes the issues driving the development of this class of network structures It provides a solid foundation in DRN systems theory and practice using consistent notation and terminology Theoretical presentations are supplemented with applications ranging from cognitive modeling to financial forecasting A Field Guide to Dynamical Recurrent Networks will enable engineers research scientists academics and graduate students to apply DRNs to

various real world problems and learn about different areas of active research It provides both state of the art information and a road map to the future of cutting edge dynamical recurrent networks

Application and Theory of Petri Nets

1999 Susanna Donatelli, Jetty Kleijn, 2003-07-31 This book constitutes the refereed proceedings of the 20th International Conference on Application and Theory of Petri Nets ICATPN 99 held in Williamsburg Virginia USA in June 1999 The 21 revised full papers presented were carefully selected from 45 submissions Also included are three invited presentations The book presents state of the art research results on all current aspects of Petri nets as well as advanced applications in a variety of areas

Domain-Specific Computer Architectures for Emerging Applications

Chao Wang, 2024-06-04 With the end of Moore's Law domain specific architecture DSA has become a crucial mode of implementing future computing architectures This book discusses the system level design methodology of DSAs and their applications providing a unified design process that guarantees functionality performance energy efficiency and real time responsiveness for the target application DSAs often start from domain specific algorithms or applications analyzing the characteristics of algorithmic applications such as computation memory access and communication and proposing the heterogeneous accelerator architecture suitable for that particular application This book places particular focus on accelerator hardware platforms and distributed systems for various novel applications such as machine learning data mining neural networks and graph algorithms and also covers RISC-V open source instruction sets It briefly describes the system design methodology based on DSAs and presents the latest research results in academia around domain specific acceleration architectures Providing cutting edge discussion of big data and artificial intelligence scenarios in contemporary industry and typical DSA applications this book appeals to industry professionals as well as academicians researching the future of computing in these areas

Adaptivity and Learning Reimer Kühn, Randolph Menzel, Wolfram Menzel, Ulrich Ratsch, Michael M. Richter, Ion-Olimpiu

Stamatescu, 2013-06-29 Adaptivity and learning have in recent decades become a common concern of scientific disciplines These issues have arisen in mathematics physics biology informatics economics and other fields more or less simultaneously The aim of this publication is the interdisciplinary discourse on the phenomenon of learning and adaptivity Different perspectives are presented and compared to find fruitful concepts for the disciplines involved The authors select problems showing representative traits concerning the frame up the methods and the achievements rather than to present extended overviews

Geophysical Applications of Artificial Neural Networks and Fuzzy Logic W. Sandham, M. Leggett, 2013-06-29

The past fifteen years has witnessed an explosive growth in the fundamental research and applications of artificial neural networks ANNs and fuzzy logic FL The main impetus behind this growth has been the ability of such methods to offer solutions not amenable to conventional techniques particularly in application domains involving pattern recognition prediction and control Although the origins of ANNs and FL may be traced back to the 1940s and 1960s respectively the most rapid progress has only been achieved in the last fifteen years This has been due to significant theoretical advances in

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Cloud Computing for Optimization: Foundations, Applications, and Challenges Bhabani Shankar Prasad Mishra,Himansu Das,Satchidananda Dehuri,Alok Kumar Jagadev,2018-02-26 This book discusses harnessing the real power of cloud computing in optimization problems presenting state of the art computing paradigms advances in applications and challenges concerning both the theories and applications of cloud computing in optimization with a focus on diverse fields like the Internet of Things fog assisted cloud computing and big data In real life many problems ranging from social science to engineering sciences can be identified as complex optimization problems Very often these are intractable and as a result researchers from industry as well as the academic community are concentrating their efforts on developing methods of addressing them Further the cloud computing paradigm plays a vital role in many areas of interest like resource allocation scheduling energy management virtualization and security and these areas are intertwined with many optimization problems Using illustrations and figures this book offers students and researchers a clear overview of the concepts and practices of cloud computing and its use in numerous complex optimization problems

Bio-Inspired Computational Intelligence and Applications Minrui Fei,George W. Irwin,Shiwei Ma,2007-08-26 This book is part of a two volume work that constitutes the refereed proceedings of the International Conference on Life System Modeling and Simulation LSMS 2007 held in Shanghai China September 2007 Coverage includes advanced neural network theory advanced evolutionary computing theory ant colonies and particle swarm optimization intelligent modeling monitoring and control of complex nonlinear systems as well as biomedical signal processing imaging and visualization

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