Introduction To Artificial Neural Systems Solution Manual

The two volume set LNCS 3696 and LNCS 3697 constitutes the refereed proceedings of the 15th International Conference on Artificial Neural Networks, ICANN 2005, held in Warsaw, Poland in September 2005. The over 600 papers submitted to ICANN 2005 were thoroughly reviewed and carefully selected for presentation. The first volume includes 106 contributions related to Biological Inspirations; topics addressed are modeling the brain and cognitive functions, development of cognitive powers in embodied systems spiking neural networks, associative memory models, models of biological functions, projects in the area of neuroIT, evolutionary and other biological inspirations, self-organizing maps and their applications, computer vision, face recognition and detection, sound and speech recognition, bioinformatics, biomedical applications, and information- theoretic concepts in biomedical data analysis. The second volume contains 162 contributions related to Formal Models and their Applications and deals with new neural network models, supervised learning algorithms, ensemble-based learning, unsupervised learning, recurrent neural networks, reinforcement learning, bayesian approaches to learning, learning theory, artificial neural networks for system modeling, decision making, optimization and control, knowledge extraction from neural networks, temporal data analysis, prediction and forecasting, support vector machines and kernel-based methods, soft computing methods for data representation, analysis and processing, data fusion for industrial, medical and environmental applications, non-linear predictive models for speech processing, intelligent multimedia and semantics, applications to natural language processing, various

applications, computational intelligence in games, and issues in hardware implementation.

This book is dedicated to intelligent systems of broad-spectrum application, such as personal and social biosafety or use of intelligent sensory micro-nanosystems such as "e-nose", "e-tongue" and "e-eye". In addition to that, effective acquiring information, knowledge management and improved knowledge transfer in any media, as well as modeling its information content using meta-and hyper heuristics and semantic reasoning all benefit from the systems covered in this book. Intelligent systems can also be applied in education and generating the intelligent distributed eLearning architecture, as well as in a large number of technical fields, such as industrial design, manufacturing and utilization, e.g., in precision agriculture, cartography, electric power distribution systems, intelligent building management systems, drilling operations etc. Furthermore, decision making using fuzzy logic models, computational recognition of comprehension uncertainty and the joint synthesis of goals and means of intelligent behavior biosystems, as well as diagnostic and human support in the healthcare environment have also been made easier.

This book constitutes the proceedings of the 15th IFIP TC8 International Conference on Computer Information Systems and Industrial Management, CISIM 2016, held in Vilnius, Lithuania, in September 2016. The 63 regular papers presented together with 1 inivted paper and 5 keynotes in this volume were carefully reviewed and selected from about 89 submissions. The main topics covered are rough set methods for big data analytics; images, visualization, classification; optimization, tuning; scheduling in manufacturing and other applications; algorithms; decisions; intelligent distributed systems; and biometrics, identification, security.

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.

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.

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.

In this book, highly qualified multidisciplinary scientists grasp their recent researches motivated by the importance of artificial neural networks. It addresses advanced applications and innovative case studies for the next-generation optical networks based on modulation recognition using artificial neural networks, hardware ANN for gait generation of multi-legged robots, production of high-resolution soil property ANN maps, ANN and dynamic factor models to combine forecasts, ANN parameter recognition of engineering constants in Civil Engineering, ANN electricity consumption and generation forecasting, ANN for advanced process control, ANN breast cancer detection, ANN applications in biofuels, ANN modeling for manufacturing process optimization, spectral interference correction using a large-size spectrometer and ANN-based deep learning, solar radiation ANN prediction using NARX model, and ANN data assimilation for an atmospheric general circulation model.

Artificial Neural Systems or neural networks are physically cellular systems which can acquire, store and utilize experimental knowledge. It helps the reader to understand the acquisition and retrieval of experimental knowledge in densely interconnected networks containing cells of processing elements and interconnecting links. The book also addresses the concepts of parallel machines that are able to acquire knowledge and the corresponding issues of implementation.

Graphs are useful data structures in complex real-life

applications such as modeling physical systems, learning molecular fingerprints, controlling traffic networks, and recommending friends in social networks. However, these tasks require dealing with non-Euclidean graph data that contains rich relational information between elements and cannot be well handled by traditional deep learning models (e.g., convolutional neural networks (CNNs) or recurrent neural networks (RNNs)). Nodes in graphs usually contain useful feature information that cannot be well addressed in most unsupervised representation learning methods (e.g., network embedding methods). Graph neural networks (GNNs) are proposed to combine the feature information and the graph structure to learn better representations on graphs via feature propagation and aggregation. Due to its convincing performance and high interpretability, GNN has recently become a widely applied graph analysis tool. This book provides a comprehensive introduction to the basic concepts, models, and applications of graph neural networks. It starts with the introduction of the vanilla GNN model. Then several variants of the vanilla model are introduced such as graph convolutional networks, graph recurrent networks, graph attention networks, graph residual networks, and several general frameworks. Variants for different graph types and advanced training methods are also included. As for the applications of GNNs, the book

categorizes them into structural, non-structural, and other scenarios, and then it introduces several typical models on solving these tasks. Finally, the closing chapters provide GNN open resources and the outlook of several future directions.
Books on computation in the marketplace tend to discuss the topics within specific fields. Many computational algorithms, however, share common roots. Great advantages emerge if numerical methodologies break the boundaries and find their uses across disciplines. Interdisciplinary Computing In Java Programming Language introduces readers of different backgrounds to the beauty of the selected algorithms. Serious quantitative researchers, writing customized codes for computation, enjoy cracking source codes as opposed to the black-box approach. Most C and Fortran programs, despite being slightly faster in program execution, lack built-in support for plotting and graphical user interface. This book selects Java as the platform where source codes are developed and applications are run, helping readers/users best appreciate the fun of computation. Interdisciplinary Computing In Java Programming Language is designed to meet the needs of a professional audience composed of practitioners and researchers in science and technology. This book is also suitable for senior undergraduate and graduate-level students in computer science, as a secondary text.

This book provides an overview of the current advances in artificial intelligence and neural nets. Artificial intelligence (AI) methods have shown great capabilities in modelling, prediction and recognition tasks supporting human–machine interaction. At the same time, the issue of emotion has gained increasing attention due to its relevance in achieving human-like interaction with machines. The real challenge is taking advantage of the emotional characterization of humans' interactions to make computers interfacing with them emotionally and socially credible. The book assesses how and to what extent current sophisticated computational intelligence tools might support the multidisciplinary research on the characterization of appropriate system reactions to human emotions and expressions in interactive scenarios. Discussing the latest recent research trends, innovative approaches and future challenges in AI from interdisciplinary perspectives, it is a valuable resource for researchers and practitioners in academia and industry.

Control problems offer an industrially important application and a guide to understanding control systems for those working in Neural Networks. Neural Systems for Control represents the most up-to-date developments in the rapidly growing aplication area of neural networks and focuses on research in natural and artifical neural systems

directly applicable to control or making use of modern control theory. The book covers such important new developments in control systems such as intelligent sensors in semiconductor wafer manufacturing; the relation between muscles and cerebral neurons in speech recognition; online compensation of reconfigurable control for spacecraft aircraft and other systems; applications to rolling mills, robotics and process control; the usage of past output data to identify nonlinear systems by neural networks; neural approximate optimal control; model-free nonlinear control; and neural control based on a regulation of physiological investigation/blood pressure control. All researchers and students dealing with control systems will find the fascinating Neural Systems for Control of immense interest and assistance. Focuses on research in natural and artifical neural systems directly applicable to contol or making use of modern control theory Represents the most up-to-date developments in this rapidly growing application area of neural networks Takes a new and novel approach to system identification and synthesis
Lattice theory extends into virtually every branch of mathematics, ranging from measure theory and convex geometry to probability theory and topology. A more recent development has been the rapid escalation of employing lattice theory for various applications outside the domain of pure

mathematics. These applications range from electronic communication theory and gate array devices that implement Boolean logic to artificial intelligence and computer science in general. Introduction to Lattice Algebra: With Applications in AI, Pattern Recognition, Image Analysis, and Biomimetic Neural Networks lays emphasis on two subjects, the first being lattice algebra and the second the practical applications of that algebra. This textbook is intended to be used for a special topics course in artificial intelligence with a focus on pattern recognition, multispectral image analysis, and biomimetic artificial neural networks. The book is self-contained and – depending on the student's major – can be used for a senior undergraduate level or first-year graduate level course. The book is also an ideal self-study guide for researchers and professionals in the above-mentioned disciplines. Features Filled with instructive examples and exercises to help build understanding Suitable for researchers, professionals and students, both in mathematics and computer science Every chapter consists of exercises with solution provided online at www.Routledge.com/9780367720292

The pursuit of artificial intelligence has been a highly active domain of research for decades, yielding exciting scientific insights and productive new technologies. In terms of generating intelligence, however, this pursuit has yielded only limited

success. This book explores the hypothesis that adaptive growth is a means of moving forward. By emulating the biological process of development, we can incorporate desirable characteristics of natural neural systems into engineered designs and thus move closer towards the creation of brain-like systems. The particular focus is on how to design artificial neural networks for engineering tasks. The book consists of contributions from 18 researchers, ranging from detailed reviews of recent domains by senior scientists, to exciting new contributions representing the state of the art in machine learning research. The book begins with broad overviews of artificial neurogenesis and bio-inspired machine learning, suitable both as an introduction to the domains and as a reference for experts. Several contributions provide perspectives and future hypotheses on recent highly successful trains of research, including deep learning, the Hyper NEAT model of developmental neural network design, and a simulation of the visual cortex. Other contributions cover recent advances in the design of bio-inspired artificial neural networks, including the creation of machines for classification, the behavioural control of virtual agents, the desi gn of virtual multi-component robots and morphologies and the creation of flexible intelligence. Throughout, the contributors share their vast expertise on the means and benefits of creating brain-like machines. This book is appropriate for

advanced students and practitioners of artificial intelligence and machine learning.

Elements of Artificial Neural Networks provides a clearly organized general introduction, focusing on a broad range of algorithms, for students and others who want to use neural networks rather than simply study them. The authors, who have been developing and team teaching the material in a one-semester course over the past six years, describe most of the basic neural network models (with several detailed solved examples) and discuss the rationale and advantages of the models, as well as their limitations. The approach is practical and open-minded and requires very little mathematical or technical background. Written from a computer science and statistics point of view, the text stresses links to contiguous fields and can easily serve as a first course for students in economics and management. The opening chapter sets the stage, presenting the basic concepts in a clear and objective way and tackling important -- yet rarely addressed -- questions related to the use of neural networks in practical situations. Subsequent chapters on supervised learning (single layer and multilayer networks), unsupervised learning, and associative models are structured around classes of problems to which networks can be applied. Applications are discussed along with the algorithms. A separate chapter takes up optimization methods.

The most frequently used algorithms, such as backpropagation, are introduced early on, right after perceptrons, so that these can form the basis for initiating course projects. Algorithms published as late as 1995 are also included. All of the algorithms are presented using block-structured pseudo-code, and exercises are provided throughout. Software implementing many commonly used neural network algorithms is available at the book's website. Transparency masters, including abbreviated text and figures for the entire book, are available for instructors using the text.

The quest for building systems that can function automatically has attracted a lot of attention over the centuries and created continuous research activities. As users of these systems we have never been satisfied, and demand more from the artifacts that are designed and manufactured. The current trend is to build autonomous systems that can adapt to changes in their environment. While there is a lot to be done before we reach this point, it is not possible to separate manufacturing systems from this trend. The desire to achieve fully automated manufacturing systems is here to stay. Manufacturing systems of the twenty-first century will demand more flexibility in product design, process planning, scheduling and process control. This may well be achieved through integrated software and hardware archi tectures that generate current decisions based on information

collected from manufacturing systems environment, and execute these decisions by converting them into signals transferred through communication network. Manufacturing technology has not yet reached this state. However, the urge for achieving this goal is transferred into the term 'Intelligent Systems' that we started to use more in late 1980s. Knowledge-based systems, our first efforts in this endeavor, were not sufficient to generate the 'Intelligence' required - our quest still continues. Artificial neural network technology is becoming an integral part of intelligent manufacturing systems and will have a profound impact on the design of autonomous engineering systems over the next few years.

`Readers will emerge with a rigorous statistical grounding in the theory of how to construct and train neural networks in pattern recognition' New Scientist The book reports on the latest theories on artificial neural networks, with a special emphasis on bio-neuroinformatics methods. It includes twenty-three papers selected from among the best contributions on bio-neuroinformatics-related issues, which were presented at the International Conference on Artificial Neural Networks, held in Sofia, Bulgaria, on September 10-13, 2013 (ICANN 2013). The book covers a broad range of topics concerning the theory and applications of artificial neural networks, including recurrent neural networks, super-Turing computation and reservoir computing, double-layer

vector perceptrons, nonnegative matrix factorization, bio-inspired models of cell communities, Gestalt laws, embodied theory of language understanding, saccadic gaze shifts and memory formation, and new training algorithms for Deep Boltzmann Machines, as well as dynamic neural networks and kernel machines. It also reports on new approaches to reinforcement learning, optimal control of discrete time-delay systems, new algorithms for prototype selection, and group structure discovering. Moreover, the book discusses one-class support vector machines for pattern recognition, handwritten digit recognition, time series forecasting and classification, and anomaly identification in data analytics and automated data analysis. By presenting the state-of-the-art and discussing the current challenges in the fields of artificial neural networks, bioinformatics and neuroinformatics, the book is intended to promote the implementation of new methods and improvement of existing ones, and to support advanced students, researchers and professionals in their daily efforts to identify, understand and solve a number of open questions in these fields.

For convenience, many of the proofs of the key theorems have been rewritten so that the entire book uses a relatively uniform notion.

Modern neural networks gave rise to major breakthroughs in several research areas. In

neuroscience, we are witnessing a reappraisal of neural network theory and its relevance for understanding information processing in biological systems. The research presented in this book provides various perspectives on the use of artificial neural networks as models of neural information processing. We consider the biological plausibility of neural networks, performance improvements, spiking neural networks and the use of neural networks for understanding brain function.

In addition to showing the programmer how to construct Neural Networks, the book discusses the Java Object Oriented Neural Engine (JOONE), a free open source Java neural engine. (Computers) 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.

Originating from models of biological neural systems, artificial neural networks (ANN) are the cornerstones of artificial intelligence research. Catalyzed by the upsurge in computational power and availability, and made widely accessible with the co-evolution of software, algorithms, and methodologies, artificial neural networks have had a profound impact in the elucidation of complex biological, chemical, and environmental processes. Artificial Neural Networks in Biological and Environmental Analysis provides an in-depth and timely perspective on the fundamental, technological, and applied aspects of computational neural networks. Presenting the basic principles of neural networks together with applications in the field, the book stimulates communication and partnership among scientists in fields as diverse as biology, chemistry, mathematics, medicine, and

environmental science. This interdisciplinary discourse is essential not only for the success of independent and collaborative research and teaching programs, but also for the continued interest in the use of neural network tools in scientific inquiry. The book covers: A brief history of computational neural network models in relation to brain function Neural network operations, including neuron connectivity and layer arrangement Basic building blocks of model design, selection, and application from a statistical perspective Neurofuzzy systems, neuro-genetic systems, and neuro-fuzzy-genetic systems Function of neural networks in the study of complex natural processes Scientists deal with very complicated systems, much of the inner workings of which are frequently unknown to researchers. Using only simple, linear mathematical methods, information that is needed to truly understand natural systems may be lost. The development of new algorithms to model such processes is needed, and ANNs can play a major role. Balancing basic principles and diverse applications, this text introduces newcomers to the field and reviews recent developments of interest to active neural network practitioners.

Comprehensive introduction to the neural network models currently under intensive study for computational applications. It also provides coverage of neural network applications in a variety of problems of both theoretical and practical interest.

Neural Networks for Perception, Volume 1: Human and Machine Perception focuses on models for understanding human perception in terms of distributed

computation and examples of PDP models for machine perception. This book addresses both theoretical and practical issues related to the feasibility of both explaining human perception and implementing machine perception in terms of neural network models. The book is organized into two parts. The first part focuses on human perception. Topics on network model of object recognition in human vision, the self-organization of functional architecture in the cerebral cortex, and the structure and interpretation of neuronal codes in the visual system are detailed under this part. Part two covers the relevance of neural networks for machine perception. Subjects considered under this section include the multi-dimensional linear lattice for Fourier and Gabor transforms, multiple- scale Gaussian filtering, and edge detection; aspects of invariant pattern and object recognition; and neural network for motion processing. Neuroscientists, computer scientists, engineers, and researchers in artificial intelligence will find the book useful.

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.

This book presents carefully revised versions of tutorial lectures given during a School on Artificial Neural Networks for the industrial world held at the University of Limburg in Maastricht, Belgium. The major ANN architectures are discussed to show their powerful possibilities for empirical data analysis, particularly in situations where other methods seem to fail. Theoretical insight is offered by examining the underlying mathematical principles in a detailed, yet clear and illuminating way. Practical experience is provided by discussing several real-world applications in such areas as control, optimization, pattern recognition, software engineering, robotics, operations research, and CAM.

Artificial Intelligence in the Age of Neural Networks and Brain Computing demonstrates that existing disruptive implications and applications of AI is a development of the unique attributes of neural networks, mainly machine learning, distributed architectures, massive parallel processing, black-box inference, intrinsic nonlinearity and smart autonomous search engines. The book covers the major basic ideas of brain-like computing behind AI, provides a framework to deep learning, and launches novel and intriguing paradigms as future alternatives. The success of AI-based commercial products proposed by top industry leaders, such as Google, IBM, Microsoft, Intel and Amazon can be interpreted using this book. Developed from the 30th anniversary of the International Neural Network Society (INNS) and the 2017 International Joint Conference on Neural Networks

(IJCNN) Authored by top experts, global field pioneers
and researchers working on cutting-edge applications in
signal processing, speech recognition, games, adaptive
control and decision-making Edited by high-level
academics and researchers in intelligent systems and
neural networks

Introduction to Deep Learning and Neural Networks with
PythonTM: A Practical Guide is an intensive step-by-step
guide for neuroscientists to fully understand, practice,
and build neural networks. Providing math and
PythonTM code examples to clarify neural network
calculations, by book's end readers will fully understand
how neural networks work starting from the simplest
model Y=X and building from scratch. Details and
explanations are provided on how a generic gradient
descent algorithm works based on mathematical and
PythonTM examples, teaching you how to use the
gradient descent algorithm to manually perform all
calculations in both the forward and backward passes of
training a neural network. Examines the practical side of
deep learning and neural networks Provides a problem-
based approach to building artificial neural networks
using real data Describes PythonTM functions and
features for neuroscientists Uses a careful tutorial
approach to describe implementation of neural networks
in PythonTM Features math and code examples (via
companion website) with helpful instructions for easy
implementation

An intelligent system is one which exhibits characteristics
including, but not limited to, learning, adaptation, and
problem-solving. Artificial Neural Network (ANN)

Systems are intelligent systems designed on the basis of statistical models of learning that mimic biological systems such as the human central nervous system. Such ANN systems represent the theme of this book. This book also describes concepts related to evolutionary methods, clustering algorithms, and others networks which are complementary to ANN system. The book is divided into two parts. The first part explains basic concepts derived from the natural biological neuron and introduces purely scientific frameworks used to develop a viable ANN model. The second part expands over to the design, analysis, performance assessment, and testing of ANN models. Concepts such as Bayesian networks, multi-classifiers, and neuromorphic ANN systems are explained, among others. Artificial Neural Systems: Principles and Practice takes a developmental perspective on the subject of ANN systems, making it a beneficial resource for students undertaking graduate courses and research projects, and working professionals (engineers, software developers) in the field of intelligent systems design.

This book provides comprehensive coverage of neural networks, their evolution, their structure, the problems they can solve, and their applications. The first half of the book looks at theoretical investigations on artificial neural networks and addresses the key architectures that are capable of implementation in various application scenarios. The second half is designed specifically for the production of solutions using artificial neural networks to solve practical problems arising from different areas of knowledge. It also describes the

various implementation details that were taken into account to achieve the reported results. These aspects contribute to the maturation and improvement of experimental techniques to specify the neural network architecture that is most appropriate for a particular application scope. The book is appropriate for students in graduate and upper undergraduate courses in addition to researchers and professionals.

The book should serve as a text for a university graduate course or for an advanced undergraduate course on neural networks in engineering and computer science departments. It should also serve as a self-study course for engineers and computer scientists in the industry. Covering major neural network approaches and architectures with the theories, this text presents detailed case studies for each of the approaches, accompanied with complete computer codes and the corresponding computed results. The case studies are designed to allow easy comparison of network performance to illustrate strengths and weaknesses of the different networks.

This book covers theoretical aspects as well as recent innovative applications of Artificial Neural networks (ANNs) in natural, environmental, biological, social, industrial and automated systems. It presents recent results of ANNs in modelling small, large and complex systems under three categories, namely, 1) Networks, Structure Optimisation, Robustness and Stochasticity 2) Advances in Modelling Biological and Environmental Systems and 3) Advances in Modelling Social and Economic Systems. The book aims at serving

undergraduates, postgraduates and researchers in ANN computational modelling.

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