# Artificial Neural Network Fuzzy Inference System Anfis

This book systematically synthesizes research achievements in the field of fuzzy neural networks in recent years. It also provides a comprehensive presentation of the developments in fuzzy neural networks, with regard to theory as well as their application to system modeling and image restoration. Special emphasis is placed on the fundamental concepts and architecture analysis of fuzzy neural networks. The book is unique in treating all kinds of fuzzy neural networks and their learning algorithms and universal approximations, and employing simulation examples which are carefully designed to help the reader grasp the underlying theory. This is a valuable reference for scientists and engineers working in mathematics, computer science, control or other fields related to information processing. It can also be used as a textbook for graduate courses in applied mathematics, computer science, automatic control and electrical engineering.

Neural networks and fuzzy systems are different approaches to introducing human-like reasoning into expert systems. This text is the first to combine the study of these two subjects, their basics and their use, along with symbolic AI methods to build comprehensive artificial intelligence systems. In a clear and accessible style, Kasabov describes rule- based and connectionist techniques and then their combinations, with fuzzy logic included, showing the application of the different techniques to a set of simple prototype problems, which makes comparisons possible. A particularly strong feature of the text is that it is filled with applications in engineering, business, and finance. AI problems that cover most of the application-oriented research in the field (pattern recognition, speech and image processing, classification, planning, optimization, prediction, control, decision making, and game simulations) are discussed and illustrated with concrete examples. Intended both as a text for advanced undergraduate and postgraduate students as well as a reference for researchers in the field of knowledge engineering, Foundations of Neural Networks, Fuzzy Systems, and Knowledge Engineering has chapters structured for various levels of teaching and includes original work by the author along with the classic material. Data sets for the examples in the book as well as an integrated software environment that can be used to solve the problems and do the exercises at the end of each chapter are available free through anonymous ftp.

The purpose of this book is to present a methodology for designing and tuning fuzzy expert systems in order to identify nonlinear objects; that is, to build input-output models using expert and experimental information. The results of these identifications are used for direct and inverse fuzzy evidence in forecasting and diagnosis problem solving. The book is organised as follows: Chapter 1 presents the basic knowledge about fuzzy sets, genetic algorithms and neural nets necessary for a clear understanding of the rest of this book. Chapter 2 analyzes direct fuzzy inference based on fuzzy if-then rules. Chapter 3 is devoted to the tuning of fuzzy rules for direct inference using genetic algorithms and neural nets. Chapter 4 presents models and algorithms for extracting fuzzy rules from experimental data. Chapter 5 describes a method for solving fuzzy logic equations necessary for the inverse fuzzy inference in diagnostic systems. Chapters 6 and 7 are devoted to inverse fuzzy inference based on fuzzy relations and fuzzy rules. Chapter 8 presents a method for extracting fuzzy relations from data. All the algorithms presented in Chapters 2-8 are validated by computer experiments and illustrated by solving medical and technical forecasting and diagnosis problems. Finally, Chapter 9 includes applications of the proposed methodology in dynamic and inventory control systems, prediction of results of football games, decision making in road accident investigations, project management and reliability analysis.

Fuzzy sets were introduced by Zadeh (1965) as a means of representing and manipulating data that was not precise, but rather fuzzy. Fuzzy logic pro vides an inference morphology that enables approximate human reasoning capabilities to be applied to knowledge-based systems. The theory of fuzzy logic provides a mathematical strength to capture the uncertainties associ ated with human cognitive processes, such as thinking and reasoning. The conventional approaches to knowledge representation lack the means for rep resentating the meaning of fuzzy concepts. As a consequence, the approaches based on first order logic and classical probablity theory do not provide an appropriate conceptual framework for dealing with the representation of com monsense knowledge, since such knowledge is by its nature both lexically imprecise and noncategorical. The developement of fuzzy logic was motivated in large measure by the need for a conceptual framework which can address the issue of uncertainty and lexical imprecision. Some of the essential characteristics of fuzzy logic relate to the following [242]. • In fuzzy logic, exact reasoning is viewed as a limiting case of ap proximate reasoning. • In fuzzy logic, everything is a matter of degree. • In fuzzy logic, knowledge is interpreted a collection of elastic or, equivalently, fuzzy constraint on a collection of variables. • Inference is viewed as a process of propagation of elastic con straints. • Any logical system can be fuzzified. There are two main characteristics of fuzzy systems that give them better performance f ü r specific applications.

Remaining Useful Life (RUL) Prediction of electrolytic Capacitor using Artificial Intelligence

Fuzzy Learning and Applications

Do Smart Adaptive Systems Exist?

Proceedings of the 1995 World Congress on Neural Networks

Neuro-Fuzzy Architectures and Hybrid Learning

**Deep Neuro-Fuzzy Systems with PythonWith Case Studies and Applications from the IndustryApress**

**In this guide designed for researchers and students of computer science, readers will find a resource for how to apply methods that work on real-life problems to their challenging applications, and a go-to work that makes fuzzy clustering issues and aspects clear.**

**The advent of the computer age has set in motion a profound shift in our perception of science -its structure, its aims and its evolution. Traditionally, the principal domains of science were, and are, considered to be mathe matics, physics, chemistry, biology, astronomy and related disciplines. But today, and to an increasing extent, scientific progress is being driven by a quest for machine intelligence - for systems which possess a high MIQ (Machine IQ) and can perform a wide variety of physical and mental tasks with minimal human intervention. The role model for intelligent systems is the human mind. The influ ence of the human mind as a role model is clearly visible in the methodolo gies which have emerged, mainly during the past two decades, for the con ception, design and utilization of intelligent systems. At the center of these methodologies are fuzzy logic (FL); neurocomputing (NC); evolutionary computing (EC); probabilistic computing (PC); chaotic computing (CC); and machine learning (ML). Collectively, these methodologies constitute what is called soft computing (SC). In this perspective, soft computing is basically a coalition of methodologies which collectively provide a body of concepts and techniques for automation of reasoning and decision-making in an environment of imprecision, uncertainty and partial truth.**

**Modeling is a helpful tool that might be used to predict the Dissolved Oxygen (DO) level of a lake. Most ecological systems are complex and unstable. In case black box models might be essential instead of deterministic ones. DO in Eymir Lake was modeled by using both Artificial Neural Networks (ANN) and**

**Adaptive Neuro Fuzzy Inference System (ANFIS). Phosphate, Orthophospate, pH, Chlorophyll-a, Temperature, Alkalinity, Nitrate, Total Kjeldahl Nitrogen, Wind, Precipitation, Air Temperature were the input parameters of ANN and ANFIS. The aims of these modeling studies were: developing models with ANN to predict DO level in Lake Eymir with high fidelity to actual DO data, to compare the success of ANN and ANFIS on DO modeling, to determine the degree of dependence of different parameters on DO. "Matlab R 2007b" software was used. The results indicated that ANN has high prediction capacity of DO and ANFIS has low with respect to ANN. Failure of ANFIS was due to low functionality of Matlab ANFIS. For ANN Modeling effect of meteorological data on DO data on surface of the lake was successfully described and summer month super saturation DO concentrations were successfully predicted.**

**An Application of Artificial Neural Network, Fuzzy Inference, and Expert System Technologies**

**New Hybrid Intelligent Systems for Diagnosis and Risk Evaluation of Arterial Hypertension**

**Foundations of Neural Networks, Fuzzy Systems, and Knowledge Engineering**

**Improving Peanut Maturity Prediction Using a Hybrid Artificial Neural Network and Fuzzy Inference System**

**Deep Neuro-Fuzzy Systems with Python**

The U.S. water distribution system contains thousands of miles of pipes with differing materials, sizes, and ages. These pipes experience physical, environmental, structural and operational parameters that cause corrosion and eventually lead to their failures. The Remaining Useful Life (RUL) is the estimated time before a pipe will experience a failure mode specifically a pipe break. Pipe failure means collapse and deterioration of water pipes overtime. Pipe deterioration results in increased break rates, reduced hydraulic capacity, and detrimental impacts on water quality. Therefore, it is crucial to perform accurate models that can forecast deterioration rates along with estimates of remaining useful life of pipelines to implement essential interference plans that can reduce catastrophic failures. This dissertation discusses a computational model that forecasts the RUL of water pipelines using Artificial Neural Network (ANN) and Adaptive Neural Fuzzy Inference System (ANFIS). Artificial Neural Network and ANFIS are developed using Levenberg-Marquardt backpropagation algorithm and mixture of backpropagation and least squares (hybrid method). Those models are trained and tested with acquired field data. The developed models identify the significant parameters that influence prediction of RUL. It is concluded that, on the average, with approximately 10% of wall thickness loss in existing cast iron, ductile iron, asbestos-cement and steel water pipes analyzed in this dissertation, the reduction of their remaining useful life will be approximately 50%.

In this book, a new method for hybrid intelligent systems is proposed. The proposed method is based on a granular computing approach applied in two levels. The techniques used and combined in the proposed method are modular neural networks (MNNs) with a Granular Computing (GrC) approach, thus resulting in a new concept of MNNs; modular granular neural networks (MGNNs). In addition fuzzy logic (FL) and hierarchical genetic algorithms (HGAs) are techniques used in this research work to improve results. These techniques are chosen because in other works have demonstrated to be a good option, and in the case of MNNs and HGAs, these techniques allow to improve the results obtained than with their conventional versions; respectively artificial neural networks and genetic algorithms.

Master's Thesis from the year 2017 in the subject Engineering - Artificial Intelligence, grade: 9.00, Lovely Professional University, Punjab (Lovely professional university, Punjab), course: M.Tech, language: English, abstract: Residual life prediction is the technique which demonstrates how reliable a particular electronic system or component works under in specific operating conditions. The remaining useful life relies on the failure rate of a component and on the operating conditions of a device. This failure rate drifts for the duration of the life of the item with time. Life is an important aspect while choosing the electronic hardware. Residual life estimation and life prediction are two distinct terms. The importance of life estimation is to evaluate the remaining useful life of a specific component under the different stress parameters. As an increasing number of components are integrated on to a chip, the chances of failure increase, as the different parts have their own stress factors and different working conditions. So the condition monitoring strategies are utilized which enhances the reliability of a component and a suitable move to be made before any harmful breakdown happens. The electronic circuits need a failure estimation technique to protect the system from unavoidable failures. Residual life estimation of electronic components is an important fact these days as electronic components and devices becomes a great need of society. Residual life prediction is predicting the remaining useful life of a component or device based on various failure factors of any component and it also depends on the operating conditions. Many methods for predicting the life of electronic components have been developed. The life of electronic components can be predicted by creating an intelligent system for the failure analysis. The capability to predict the life of electronic components is a key to prevent the sudden costly failure and it will increase the overall performance and reliability of a system. So, remaining useful life prediction is an important factor for every active and passive electronic component such as resistor, capacitor and diode etc.

Fuzzy systems and soft computing are new computing techniques that are tolerant to imprecision, uncertainty and partial truths. Applications of these techniques in nuclear engineering present a tremendous challenge due to its strict nuclear safety regulation. The fields of nuclear engineering, fuzzy systems and soft computing have nevertheless matured considerably during the last decade. This book presents new application potentials for Fuzzy Systems and Soft Computing in Nuclear Engineering. The root of this book can be traced back to the series of the first, second and third international workshops on Fuzzy Logic and Intelligent Technologies in Nuclear Science (FUNS), which were successfully held in Mol, September 14-16, 1994 (FLINS'94), in Mol, September 25-27, 1996 (FLINS'96), and in Antwerp, September 14-16, 1998 (FLINS'98). The conferences were organised by the Belgian Nuclear Research Centre (SCKeCEN) and aimed at bringing together scientists, researchers, and engineers from academia and industry, at introducing the principles of fuzzy logic, neural networks, genetic algorithms and other soft computing methodologies, to the field of nuclear engineering, and at applying these techniques to complex problem solving within nuclear industry and related research fields. This book, as its title suggests, consists of nuclear engineering applications of fuzzy systems (Chapters 1-10) and soft computing (Chapters 11-21). Nine pertinent chapters are based on the extended version of papers at FLINS'98 and the other 12 chapters are original contributions with up-to-date coverage of fuzzy and soft computing applications by leading researchers written exclusively for this book.

Handbook of Research on Pattern Engineering System Development for Big Data Analytics
Proceedings of the Fifth International Conference on Fuzzy and Neuro Computing (FANCCO - 2015)
NEURAL NETWORKS, FUZZY SYSTEMS AND EVOLUTIONARY ALGORITHMS : SYNTHESIS AND APPLICATIONS
Remaining Useful Life Prediction of Water Pipes Using Artificial Neural Network and Adaptive
Neuro Fuzzy Inference System Models
Advances in Computing and Information Technology

"This book offers an outlook of the most recent works at the field of the Artificial Neural Networks (ANN), including theoretical developments and applications of systems using intelligent characteristics for adaptability"--Provided by publisher.

Centered around major topic areas of both theoretical and practical importance, the World Congress on Neural Networks provides its registrants -- from a diverse background encompassing industry, academia, and government -- with the latest research and applications in the neural network field.

This book is an attempt to accumulate the researches on diverse inter disciplinary field of engineering and management using Fuzzy Inference System (FIS). The book is organized in seven sections with twenty two chapters, covering a wide range of applications. Section I, caters theoretical aspects of FIS in chapter one. Section II, dealing with FIS applications to management related problems and consisting three chapters. Section III, accumulates six chapters to commemorate FIS application to mechanical and industrial engineering problems. Section IV, elaborates FIS application to image processing and cognition problems encompassing four chapters. Section V, describes FIS application to various power system engineering problem in three chapters. Section VI highlights the FIS application to system modeling and control problems and constitutes three chapters. Section VII accommodates two chapters and presents FIS application to civil engineering problem.

In this book, a new approach for diagnosis and risk evaluation of ar-terial hypertension is introduced. The new approach was implement-ed as a hybrid intelligent system combining modular neural net-works and fuzzy systems. The different responses of the hybrid system are combined using fuzzy logic. Finally, two genetic algo-rithms are used to perform the optimization of the modular neural networks parameters and fuzzy inference system parameters. The experimental results obtained using the proposed method on real pa-tient data show that when the optimization is used, the results can be better than without optimization. This book is intended to be a refer-ence for scientists and physicians interested in applying soft compu-ting techniques, such as neural networks, fuzzy logic and genetic algorithms, in medical diagnosis, but also in general to classification and pattern recognition and similar problems.

Fuzzy Evidence in Identification, Forecasting and Diagnosis
Evaluation of Artificial Neural Network (ANN) and Adaptive Neuro Based Fuzzy Inference System (ANFIS) on Sediment Transport
Proceedings of the Second International Conference on Advances in Computing and Information Technology (ACITY) July 13-15, 2012, Chennai, India - Volume 2
Theory and Practice
Computer Vision and Fuzzy-neural Systems

With low computational complexity and relatively short development time, Fuzzy Logic is an indispensable tool for engineering applications. The field is growing at an unprecedented rate, and there is a need for a book that describes essential tools, applications, examples, and perspectives in the field o learning. The editors of Fuzzy Learning and Applications fill this need, providing an essential book for researchers, scientists, and engineers alike.

Organized into four parts, this book starts with the simplest learning method and gradually arrives at the most complex. First, it summarizes all the sym and formulae used in the succeeding chapters and presents a historical overview of fuzzy learning. Next, it deals with current techniques, ranging from deterministic to hybrid methods. It then illustrates the enormous number of possibilities offered by fuzzy learning. Finally, it covers hardware dedicated fuzzy learning, from digital to analog designs and implementations. With Fuzzy Learning and Applications, readers will discover the enormous possibili fuzzy learning offers.

Soft computing is a consortium of computing methodologies that provide a foundation for the conception, design, and deployment of intelligent systems aims to formalize the human ability to make rational decisions in an environment of uncertainty and imprecision. This book is based on a NATO Advan Study Institute held in 1996 on soft computing and its applications. The distinguished contributors consider the principal constituents of soft computing,

namely fuzzy logic, neurocomputing, genetic computing, and probabilistic reasoning, the relations between them, and their fusion in industrial applications. Two areas emphasized in the book are how to achieve a synergistic combination of the main constituents of soft computing and how the combination can be used to achieve a high Machine Intelligence Quotient.

Intelligence systems. We perfonn routine tasks on a daily basis, as for example: • recognition of faces of persons (also faces not seen for many years), identification of dangerous situations during car driving, • deciding to buy or sell stock, • reading hand-written symbols, • discriminating between vines made from Sauvignon Blanc, Syrah or Merlot grapes, and others. Human experts carry out the following: • diagnosing diseases, • localizing faults in electronic circuits, • optimal moves in chess games. It is possible to design artificial systems to replace or "duplicate" the human expert. There are man possible definitions of intelligence systems. One of them is that: an intelligence system is a system able to make decisions that would be regarded as intelligent ifthey were observed in humans. Intelligence systems adapt themselves using some example situations (inputs of a system) and their correc decisions (system's output). The system after this learning phase can make decisions automatically for future situations. This system can also perfonn difficult or impossible to do for humans, as for example: compression of signals and digital channel equalization.

This proceedings bring together contributions from researchers from academia and industry to report the latest cutting edge research made in the area Fuzzy Computing, Neuro Computing and hybrid Neuro-Fuzzy Computing in the paradigm of Soft Computing. The FANCCO 2015 conference explored application areas, design novel hybrid algorithms for solving different real world application problems. After a rigorous review of the 68 submissions fro all over the world, the referees panel selected 27 papers to be presented at the Conference. The accepted papers have a good, balanced mix of theory applications. The techniques ranged from fuzzy neural networks, decision trees, spiking neural networks, self organizing feature map, support vector regression, adaptive neuro fuzzy inference system, extreme learning machine, fuzzy multi criteria decision making, machine learning, web usage minin Takagi-Sugeno Inference system, extended Kalman filter, Goedel type logic, fuzzy formal concept analysis, biclustering etc. The applications ranged fr social network analysis, twitter sentiment analysis, cross domain sentiment analysis, information security, education sector, e-learning, information management, climate studies, rainfall prediction, brain studies, bioinformatics, structural engineering, sewage water quality, movement of aerial vehicle etc.

Fuzzy Systems Engineering

Intelligent GMAW Process Control System

New Backpropagation Algorithm with Type-2 Fuzzy Weights for Neural Networks

Neural Network-based Fuzzy Inference System

Determining Geophysical Properties from Well Log Data Using Artificial Neural Networks and Fuzzy Inference Systems

**CD-ROM contains: BackProp -- Data files -- Display -- Images -- MATLAB examples**

**This book describes hybrid intelligent systems using type-2 fuzzy logic and modular neural networks for pattern recognition applications. Hybrid intelligent systems combine several intelligent computing paradigms, including fuzzy logic, neural networks, and bio-inspired optimization algorithms, which can be used to produce powerful pattern recognition systems. Type-2 fuzzy logic is an extension of traditional type-1 fuzzy logic that enables managing higher levels of uncertainty in complex real world problems, which are of particular importance in the area of pattern recognition. The book is organized in three main parts, each containing a group of chapters built around a similar subject. The first part consists of chapters with the main theme of theory and design algorithms, which are basically chapters that propose new models and concepts, which are the basis for achieving intelligent pattern recognition. The second part contains chapters with the main theme of using type-2 fuzzy models and modular neural networks with the aim of designing intelligent systems for complex pattern recognition problems, including iris, ear, face and voice recognition. The third part contains chapters with the theme of evolutionary optimization of type-2 fuzzy systems and modular neural networks in the area of intelligent pattern recognition, which includes the application of genetic algorithms for obtaining optimal type-2 fuzzy integration systems and ideal neural network architectures for solving problems in this area.**

**A feed forward Artificial Neural Network (ANN) and an Adaptive Neuro-Fuzzy Inferences System (ANFIS) reservoir inflow models were developed to investigate their potential in forecasting reservoir inflows. The site for the study is the Sembrong dam catchment which is located about 10km from Air Hitam town on the Air Hitam-Kluang road in the state of Johor, with an area of 130 square kilometers. The models consists of 9 inputs (previous last five-day reservoir inflow and last four-day average rainfall across the catchment) and are able to forecast the next day inflow into the reservoir. Average rainfall across the catchment was calculated by Theissen polygons. The 6 years daily data from 1995-1997 and 2002-2004 were used for training and validation of the models. Cross validation of training and validation data sets was also considered to obtain the best data set. Daily reservoir inflow was computed using a water balance equation. The reservoir inflow and rainfall data sets were examined for normal distribution and the best data transformation was used. Autocorrelation, partial autocorrelation and cross correlation functions were used to find the best model inputs. The ANN models were trained and simulated using a written program in MATLAB environment (M-file) with raw and transformed data. The ANFIS models were built using the Fuzzy Toolbox of MATLAB. The Subtractive Clustering (SC) technique was employed to find the optimal number of rules. Different ANFIS structures were constructed by changing the SC parameters. All models were trained by the ANFIS editor of MATLAB with hybrid method. An M-file was written for calculating the different performance criteria of ANFIS models after simulating models during training, validation and testing. After selecting the best ANFIS structure, the response of the model to different types of membership functions was investigated. The models were tested with the 10 months daily data of 2005. The best architecture of the ANN**

**model was a 9-13-1 model which means a model with 9 inputs, 1 hidden layer with 13 neurons and 1 output. The model was trained based on the Leven-berg Marquardt algorithm with sigmoid activation functions. Simulation results for the independent testing data series showed that the model can perform well in simulating peak flows as well as base flows. The ANN model has been constructed for a strong non-linear input/output data. Comparisons of different ANN models for different data sets revealed that cross validation of data was effective in improving models performances. Data pre-processing to transform data to normal distribution before the training, results in better generalization and persistency of ANN models during testing. The ANFIS models were built using the best data subset resulting from ANN modeling. The models were trained with normalized and non-normalized data. The selected ANFIS model was trained with normalized data with 6 Gaussian membership functions for each of 9 inputs and 6 rules. Comparisons of different performances of ANFIS models showed that data normalization can improve the model performances during training and testing. Simulation results for the independent test data series by the ANFIS model showed the ability of this model to forecast daily reservoir inflow in a tropical ungauged catchment. Sensitivity of the ANFIS model using different types of membership functions indicated that the best one is the Gaussian membership function. The simulation results from the selected ANFIS and ANN models during training, validation and testing revealed the superiority of the ANN model. The selected ANFIS model gives lower values in most of the performance indices during training. For validation and testing, all performance indices of selected ANFIS model were inferior to those of the ANN model. The weakness of ANFIS model is shown in its inability to forecast individual peak flows. The sudden flow changes in these small tropical catchments resulting in these peak flows are common due to their small areal extent and to the intense localized phenomenon of tropical showers.**

**The international conference on Advances in Computing and Information technology (ACITY 2012) provides an excellent international forum for both academics and professionals for sharing knowledge and results in theory, methodology and applications of Computer Science and Information Technology. The Second International Conference on Advances in Computing and Information technology (ACITY 2012), held in Chennai, India, during July 13-15, 2012, covered a number of topics in all major fields of Computer Science and Information Technology including: networking and communications, network security and applications, web and internet computing, ubiquitous computing, algorithms, bioinformatics, digital image processing and pattern recognition, artificial intelligence, soft computing and applications. Upon a strength review process, a number of high-quality, presenting not only innovative ideas but also a founded evaluation and a strong argumentation of the same, were selected and collected in the present proceedings, that is composed of three different volumes.**

**Artificial Neural Networks in Real-life Applications**

**Theory and Applications**

**Introduction to Neuro-Fuzzy Systems**

**With Case Studies and Applications from the Industry**

**Modular Neural Networks and Type-2 Fuzzy Systems for Pattern Recognition**

Do Smart Adaptive Systems Exist? is intended as a reference and a guide summarising and focusing on best practices when using intelligent techniques and building systems requiring a degree of adaptation and intelligence. It is therefore not intended as a collection of the most recent research results, but as a practical guide for experts from other areas and industrial users interested in building solutions to their problems using intelligent techniques. One of the main issues covered is an attempt to answer the question of how to select and/or combine suitable intelligent techniques from a large pool of potential solutions. Another attractive feature of the book is that it brings together experts from neural network, fuzzy, machine learning, evolutionary and hybrid systems communities who will provide their views on how these different intelligent technologies have contributed and will contribute to creation of smart adaptive systems of the future.

The second edition of this book provides a comprehensive introduction to a consortium of technologies underlying soft computing, an evolving branch of computational intelligence, which in recent years, has turned synonymous to it. The constituent technologies discussed comprise neural network (NN), fuzzy system (FS), evolutionary algorithm (EA), and a number of hybrid systems, which include classes such as neuro-fuzzy, evolutionary-fuzzy, and neuro-evolutionary systems. The hybridization of the technologies is demonstrated on architectures such as fuzzy backpropagation network (NN-FS hybrid), genetic algorithm-based backpropagation network (NN-EA hybrid), simplified fuzzy ARTMAP (NN-FS hybrid), fuzzy associative memory (NN-FS hybrid), fuzzy logic controlled genetic algorithm (EA-FS hybrid) and evolutionary extreme learning machine (NN-EA hybrid) Every architecture has been discussed in detail through illustrative examples and applications. The algorithms have been presented in pseudo-code with a step-by-step illustration of the same in problems. The applications, demonstrative of the potential of the architectures, have been chosen from diverse disciplines of science and engineering. This book, with a wealth of information that is clearly presented and illustrated by many examples and applications, is designed for use as a text for the courses in soft computing at both the senior undergraduate and first-year postgraduate levels of computer science and engineering. It should also be of interest to researchers and technologists desirous of applying soft computing technologies to their respective fields of work.

Traditional Artificial Intelligence (AI) systems adopted symbolic processing as their main paradigm. Symbolic AI systems have proved effective in handling problems characterized by exact and complete knowledge representation. Unfortunately, these systems have very little power in dealing with imprecise, uncertain and incomplete data and information which significantly contribute to the description of many real world problems, both physical systems and processes as well as mechanisms of decision making. Moreover, there are many situations where the expert domain knowledge (the basis for many symbolic AI systems) is not sufficient for the design of intelligent systems, due to incompleteness of the existing knowledge, problems caused by different biases of human experts, difficulties in forming rules, etc. In general, problem knowledge for solving a given problem can consist of an explicit knowledge (e.g., heuristic rules provided by a domain an implicit, hidden knowledge "buried" in past-experience expert) and numerical data. A study of huge amounts of these data (collected in databases) and the synthesizing of the knowledge "encoded" in them (also referred to as knowledge discovery in data or data mining), can significantly improve the performance of

the intelligent systems designed.
This paper proposes a neural network-based fuzzy inference system. The main innovation of the system is to use a neural network to express relations among fuzzy sets. To begin, we show how to represent a relation among fuzzy sets compactly using a neural network structure. We then demonstrate that it is possible to successfully train and utilize the fuzzy network with only a partial description of a desired relation among fuzzy sets. Finally, we extend our algorithms to infer fuzzy rules based on the trained fuzzy rule-base neural networks and show several examples of fuzzy inference models made using our system.
Fuzzy Systems and Soft Computing in Nuclear Engineering
Handbook of Food and Bioprocess Modeling Techniques
Neural Network and Fuzzy Logic Implementation on Lake Ecosystems
Computational Intelligence: Soft Computing and Fuzzy-Neuro Integration with Applications
Fuzzy and Neuro-Fuzzy Intelligent Systems

Gain insight into fuzzy logic and neural networks, and how the integration between the two models makes intelligent systems in the current world. This book simplifies the implementation of fuzzy logic and neural network concepts using Python. You'll start by walking through the basics of fuzzy sets and relations, and how each member of the set has its own membership function values. You'll also look at different architectures and models that have been developed, and how rules and reasoning have been defined to make the architectures possible. The book then provides a closer look at neural networks and related architectures, focusing on the various issues neural networks may encounter during training, and how different optimization methods can help you resolve them. In the last section of the book you'll examine the integrations of fuzzy logics and neural networks, the adaptive neuro fuzzy Inference systems, and various approximations related to the same. You'll review different types of deep neuro fuzzy classifiers, fuzzy neurons, and the adaptive learning capability of the neural networks. The book concludes by reviewing advanced neuro fuzzy models and applications. What You'll Learn Understand fuzzy logic, membership functions, fuzzy relations, and fuzzy inferenceReview neural networks, back propagation, and optimizationWork with different architectures such as Takagi-Sugeno model, Hybrid model, genetic algorithms, and approximations Apply Python implementations of deep neuro fuzzy system Who This book Is For Data scientists and software engineers with a basic understanding of Machine Learning who want to expand into the hybrid applications of deep learning and fuzzy logic.
With the advancement of computers, the use of modeling to reduce time and expense, and improve process optimization, predictive capability, process automation, and control possibilities, is now an integral part of food science and engineering. New technology and ease of use expands the range of techniques that scientists and researchers have at the
In this book a neural network learning method with type-2 fuzzy weight adjustment is proposed. The mathematical analysis of the proposed learning method architecture and the adaptation of type-2 fuzzy weights are presented. The proposed method is based on research of recent methods that handle weight adaptation and especially fuzzy weights.The internal operation of the neuron is changed to work with two internal calculations for the activation function to obtain two results as outputs of the proposed method. Simulation results and a comparative study among monolithic neural networks, neural network with type-1 fuzzy weights and neural network with type-2 fuzzy weights are presented to illustrate the advantages of the proposed method.The proposed approach is based on recent methods that handle adaptation of weights using fuzzy logic of type-1 and type-2. The proposed approach is applied to a cases of prediction for the Mackey-Glass (for ô=17) and Dow-Jones time series, and recognition of person with iris biometric measure. In some experiments, noise was applied in different levels to the test data of the Mackey-Glass time series for showing that the type-2 fuzzy backpropagation approach obtains better behavior and tolerance to noise than the other methods.The optimization algorithms that were used are the genetic algorithm and the particle swarm optimization algorithm and the purpose of applying these methods was to find the optimal type-2 fuzzy inference systems for the neural network with type-2 fuzzy weights that permit to obtain the lowest prediction error.
This book is devoted to reporting innovative and significant progress in fuzzy system engineering. Given the maturation of fuzzy logic, this book is dedicated to exploring the recent breakthroughs in fuzziness and soft computing in favour of intelligent system engineering. This monograph presents novel developments of the fuzzy theory as well as interesting applications of the fuzzy logic exploiting the theory to engineer intelligent systems.
Options Pricing
Fuzzy Inference System
Neuro-Fuzzy and Fuzzy Neural Synergisms
Artificial Neural Networks and Adaptive Neuro-fuzzy Inference Systems for Structural Damage Identification Using Vibration Data

**Fuzzy and Neuro-Fuzzy Systems in Medicineprovides a thorough review of state-of-the-art techniques and practices, defines and explains relevant problems, as well as provides solutions to these problems. After an introduction, the book progresses from one topic to another - with a linear development from fundamentals to applications.**
**Due to the growing use of web applications and communication devices, the use of data has increased throughout various industries. It is necessary to develop new techniques for managing data in order to ensure adequate usage. The Handbook of Research on Pattern Engineering System Development for Big Data Analytics is a critical scholarly resource that examines the incorporation of pattern management in business technologies as well as decision making and prediction process through the use of data management and analysis. Featuring coverage on a broad range of topics such as business intelligence, feature extraction, and data collection, this publication is geared towards professionals, academicians, practitioners, and researchers seeking current research on the development of pattern management systems for business applications.**
**A Comparative Analysis of Black-Scholes Model, Artificial Neural Networks (ANNs), and Adaptive Neuro-fuzzy Inference System (ANFIS)**

**Fuzzy and Neuro-Fuzzy Systems in Medicine**
**Best Practice for Selection and Combination of Intelligent Methods**
**Hierarchical Modular Granular Neural Networks with Fuzzy Aggregation**
**A Guide to Adaptive Neuro-Fuzzy Systems for Fuzzy Clustering Under Uncertainty Conditions**