Preface

The world we live in is becoming ever more reliant on the use of electronic gadgets and computers to control the behavior of real world resources. For example, an increasing amount of commerce is performed without a single bank note or coin ever being exchanged. Similarly, airports can safely land and send off aeroplanes without even looking out of a window. Another, more individual, example is the increasing use of electronic personal organizers for organizing meetings and contacts. All of these examples share a similar structure; multiple parties (e.g. aeroplanes, or people) come together to coordinate their activities in order to achieve a common goal. It is not surprising, then, that a lot of research is being done on how the mechanics of the coordination process can be automated using computers. This is where neural networks come in.

Neural networks are important for their ability to adapt. Neural nets represent entirely different models from those related to other symbolic systems. The difference occurs in the way the nets store and retrieve information. The information in a neural net is found to be distributed throughout the network and not localized. The nets are capable of making memory associations. They can handle a large amount of data, fast and efficiently. They are also fault tolerant, i.e. even if a few neurons fail, it will not disable the entire system.

The paradigm of artificial neural networks, developed to emulate some of the capabilities of the human brain, has demonstrated great potential for various low-level computations and embodies salient features such as learning, fault-tolerance, parallelism and generalization. Neural networks, comprising processing elements called neurons, are capable of coping with computational complexity, non-linearity and uncertainty. In view of this versatility of neural networks, it is believed that they hold great potential as building blocks for a variety of behaviors associated with human cognition. However, the subjective phenomena such as reasoning and perceptions are often regarded beyond the domain of the neural network theory. Neural networks can deal with imprecise data and ill-defined activities; thus they offer low-level computational features.

About the Book

Neural networks, at present is a much sought-after topic, among academicians as well as program developers. This book is designed to give a broad, yet an in-depth overview of the field of neural networks. The principles of neural networks are discussed in detail, including information and useful knowledge available for various network processes. The various algorithms and solutions to the problems given in the book are well balanced and pertinent to the neural networks research projects, labs and for college and university level studies. The modern aspects of neural networks have been introduced right from the basic principles and discussed in an easy-to-understand manner, so that a beginner to the subject is able to grasp the concept of soft networks with minimal effort.

The wide variety of worked-out examples relevant to the neural network area, will help in reinforming the concepts explained. The solutions to the problems are programmed using MATLAB 6.0 and the simulated results are given. The MATLAB neural network toolbox is provided in the Appendix for easy reference.

This book provides the neural network architecture, algorithms and application procedure-oriented structures to help the reader move into the world of neural networks with ease. It also presents application of neural networks to a wide variety of fields of current interest. A few field projects are also included.

Who will Benefit

This book would be an ideal text for undergraduate students of Computer Science, Information Technology, Electrical and Electronics and Electronics and Communication engineering for their course on Neural Networks. Those pursuing MCA and taking a course on Neural Networks will find the book useful. Programmers involved in neural network applications programming will also benefit from this book.

Organization

The book includes 16 chapters altogether. The chapters are organized as follows:

Chapter 1 gives an introduction to Neural Networks Techniques. An overview of MATLAB is also discussed.

The preliminaries of the Artificial Neural Network are described in **Chapter 2**. The discussion is based on the development of artificial neural net, comparison between the biological neuron and the artificial neuron, the basic building blocks of a neural net and the terminologies used in neural net. The summary of notations is given at the end of the chapter.

Chapter 3 deals with the fundamental models of an artificial neural net. The basics of McCulloch Pitts neuron and the Hcbb net along with the concept of linear separability is given. The learning rules used in neural networks are also described in detail in this chapter.

Chapter 4 provides information regarding the Perceptron Neural Net. The architecture and algorithm of the perceptron neural net was explained along with suitable example problems. An introduction to multi layer perceptron is given.

The basic architecture and algorithm along with examples for Adaline and Madaline nets are described in **Chapter 5**.

Chapter 6 discusses pattern association nets. Pattern association nets include auto association, hetero association and bi-directional associative memory net. The learning rules used for pattern association are also given.

Feedback network is described in **Chapter 7**. The chapter mainly provides information regarding Discrete Hopfield and Continuous Hopfield nets. Their architecture, algorithm and application procedure along with solved examples are discussed in this chapter.

Chapter 8 gives details on feed forward nets. The feed forward nets described here are the Back Propagation Algorithm and the Radial Basis Function Network. Both the networks are described with

their architecture, algorithm and example problem. The merits and demerits of back propagation algorithm are also included.

Chapter 9 deals with competitive nets. The nets that come under this category are self-organizing feature map, learning vector quantization, Max net, Mexican Hat, Hamming net. All these networks are discussed in detail with their features in this chapter.

The Counter Propagation Net (CPN) used for data compression is discussed in **Chapter 10**. The two types of CPN, full CPN and forward only CPN are discussed along with their architecture and algorithms.

Chapter 11 describes the features of Adaptive Resonance Theory (ART). The types of ART, ART network and ART2 network are described with their respective architecture, algorithms and example problems.

The information regarding the special nets like Boltzmann machine, cascade correlation, spatio temporal network, simulated annealing, optical neural net, Cauchy machine, Gaussian machine, cognitron, neo cognitron, Boltzmann machine with learning, etc. are given in **Chapter 12**.

Chapter 13 discusses the application of neural network in arts, biomedicine, industrial and control area, data mining, robotics, pattern recognition, etc. with case studies.

Chapter 14 presents the applications of various special networks dealt in Chapter 12.

Few projects related to pattern classification, system identification using different networks with MATLAB programs are discussed in **Chapter 15**.

Chapter 16 gives a brief introduction to Fuzzy Systems and Hybrid Systems (Fuzzy Neural Hybrid and Neural Fuzzy Hybrid).

The appendices include the neural network MATLAB tool box.

In conclusion, we hope that the reader will find this book a truly helpful guide and a valuable source of information about the neural networks principles and their numerous practical applications. Critical comments and suggestions from the readers are welcome as they will help us improve the future editions of the book.

S N Sivanandam
S Sumathi
S N Deepa