Nowadays, Artificial Intelligence (AI) has been wildly developed its applications in solving the problems of the real world. Medical diagnosis is one of the most important aspects of human life that has been noticed by many researchers and scientists. Medical diagnosis has some difficulties that cause the physician mistakes during the process. Many of the difficulties are related to the vast amount of medical data, similarity of the symptoms for many of the diseases and physician skills and experiences. Such reasons encourage researchers and scientists in computer science and engineering sciences work hard to design advanced intelligent tools and techniques to diagnose the disease with acceptable performance to save the human life. Applying AI for increasing the reliability for medical decision making has been studied since some years ago and many researchers have studied in this area.

Because of the importance of using intelligent methods for increasing the accuracy of medical decision making systems, using artificial intelligence for medical diagnosis has become a major task. Clancey and Shortliffe (1984) provided the following definition: ‘Medical artificial intelligence is primarily concerned with the construction of AI programs that perform diagnosis and make therapy recommendations’.

Artificial intelligence has no reason to be applied in a field such as medical diagnosis, unless it provides acceptable conditions for solving the problems in this area. The improvements include solving the problem with fewer resources in terms of time, money and people. In the present book, the applications of artificial intelligence to attain solutions for problems that would be difficult to achieved with other techniques are investigated. In medical science and biology, there are research questions that cannot be easily solved with the traditional methods. Some search problems are straightforward and readily solved by existing methods. Some searches, however, cannot be solved by either statistical-mathematical methods, or by all-encompassing (so called ‘brute force’) informatics algorithms.
What is important about medical artificial intelligence is that it is definitely an interdisciplinary field. Researchers in such interdisciplinary field are required to have the knowledge in both sides to be able to answer the questions. In this way, they can find a way to do valid research.

One of the considerations on the mundane level is related to the examples that would be the lack of a criterion standard of diagnosis in syndromology, and its consequences. Similarly, the lack of objective diagnosis in fields of medicine does have implications for medicine as a scientific discipline.

Consulting with experts and capturing their knowledge in the form of computer programs help the health care providers and less-experts physicians to provide advice for patients and any practitioner could call on that expertise whenever a patient’s case suggested the need for careful thought about some aspect of the illness or therapy. The increasing power of the computers and their decreasing price will put a large computer within reach of every physician’s desk within a few years. The opportunity is there to improve the health-care system by improving each physician’s ability to utilize the best available knowledge and the best ways of analyzing medical problems, as encoded in easily-duplicated and updated computer programs.

Artificial Neural Network (ANN) as one of the advanced intelligent tools for medical diagnosis is a subject of researching for finding the algorithms for better medical diagnosis. ANN is an information processing tools inspired from the biological model of neural networks in human. It has various applications in many fields of the problems such as speech recognition, data mining, pattern recognition, prediction, etc.

It is pleasure to introduce the book entitled “Medical Diagnosis Using Artificial Neural Networks” which is a collection of disease samples that are diagnosed using ANN. The present book attempts to give a good view to the reader to understand practical aspects of ANN in medical diagnosis problem. Many diseases such as hepatitis, cancers, heart disorders, and so forth, are the instances for detection by ANN. Although ANN mostly can find a solution for detection of the disease, but there are various parameters that are effective in its performance. This book introduces effective parameters in improving the performance and collected various techniques for applying the ANN for medical diagnosis with a simple language. The author has written this book for those who are interested in developing intelligent methods for medical diagnosis.

On the other hand, other application of ANN in signal processing and classification are discussed and readers can learn deeply from the usage of ANN in problem solving. The last chapters of the book present the new field of AI that is Swarm Intelligence (SI) and the application of Particle Swarm Optimization (PSO) for training the ANN is investigated for solving some of the classification problems. It
is recommended to readers to learn the basic fundamental of MATLAB software in order to implement the required codes. The Netlab toolbox is the special toolbox that we used for implementing the ANN coding.

Algorithms inspired by natural phenomena have taken center-stage in the development of new computer solutions. These algorithms have been found to be very efficient in solving complex computational problems such as optimizing objective functions, pattern recognition, control objectives, image processing and filter modeling.

There exists a lot of literature on finding solutions for optimization problems. However, classical optimization algorithms such as Brute-Force Search, Breath-First Search, Uniform Cost Search and Depth First Search, do not provide suitable solutions to problems in pattern recognition, optimization of objective functions and image processing that require high-dimensional search space and complexity. In addition, techniques such as exhaustive search are not practical solutions to such problems (Flake, 1999).

Two commonly recognized aspects in the population-based heuristic algorithms are exploration (the ability of expanding the search space) and exploitation (the ability of finding the optima around a good solution). Exploring the search space to find new solutions happens in premier iterations in a heuristic search algorithm, where an algorithm must use exploration at the first iteration to avoid being trapped in a local optimum. It is necessary that a good balance between exploration and exploitation exists, in order to converge on the most optimum solution. Too much stress on exploration would cause a pure random search, whereas too much stress on exploitation would cause trapping in local search.

There has been a large body of work in the area of swarm intelligence for optimization and solving different problems. Ant Colony Optimization (ACO) is one such algorithm that is based on the indirect communication between the ants by means of chemical pheromone trails, enabling them to find short paths between their nest and food sources. Other popular heuristic algorithms include the genetic algorithm (GA) inspired from the Darwinian evolutionary theory, Artificial Immune System (AIS) that simulates the immune system (Farmer et al., 1986), and Particle Swarm Optimization (PSO) based on simulation of the swarm behavior of a flock of birds. Zne and Chou (2005) proposed a hybrid search algorithm combining the advantages of GA and ACO that is able to explore the search space and exploit the best solutions. Dorigo et al. (1996) introduced the Ant System (AS), an analogy of ACO. The main characteristics of their model are positive feedback, cooperation by transferring information, and the use of a constructive greedy heuristic where agents compete to survive. Dong et al. (2007) modeled the social foraging behavior of Escherichia coli bacteria to solve optimization problems. They proposed a hybrid approach involving GA and bacterial foraging (BF) algorithms for function optimization
problems. Rashedi et al. (2009) proposed the Gravitational Search Algorithm (GSA) based on the law of gravity and mass interactions. In their algorithm, the searcher agents are a collection of masses that interact with each other based on Newtonian gravity and the laws of motion. In yet another study, Formato (2008) introduced the Central Force Optimization (CFO), a new deterministic multi-dimensional search metaheuristic based on the metaphor of gravitational kinematics.

Overall, the review of existing literature reveals that there is no one superior method for solving optimization problems. This concept is proven by the “no free lunch theorems for optimization,” which describes that no one algorithm is able to solve all the optimization algorithms but each algorithm can solve a special class of problems. Although many algorithms developed to solve optimization problems do achieve good performance, there are still some shortcomings. For example, the standard PSO algorithm often gets trapped in local optima when solving complex multimodal problems. GA has no absolute assurance of finding a global optimum and representation of the problem for GA is often difficult. Furthermore, there are various operations such as mutation and crossover in GA that require long response times in finding the solution for some problems. Evolutionary algorithms (EA) too suffer from the slow convergence problem.

The premier audiences of the present book are undergraduate/graduate students and researchers who need to find a relationship between artificial intelligence and medical science and are interested to use informatics to improve the quality of the medical diagnosis approaches. Following is a brief description of each chapter.

Chapter 1 briefly explains the medical diagnosis definition and the useful techniques that help to improve the performance of the existing medical diagnosis systems. The reasons for importance and difficulties of medical diagnosis are explained and web based medical diagnosis system components are provided and WISER as an example is provided. In chapter 2, Artificial Intelligence is defined and the reason of importance of AI in medical diagnosis is explained. The various applications of AI in medical diagnosis such as signal processing and image processing are provided. In chapter 3, the procedure and required steps for medical diagnosis is explained and reader can learn the way to find the knowledge from the medical experts to extract the data for the intelligent system.

Chapter 4 is an explanation about Artificial Neural Network (ANN). The biological and mathematical definition of neural network is provided and the activation functions effective for processing are listed. Some figures are collected for better understanding. Types of neural networks and provides some basic definitions related to feedforward and recurrent neural networks are explained in chapter 5. Another definition in this chapter is Back Propagation and it is explained how the networks decrease the error using the feedback. In chapter 6 the reader will basically get familiar with some of the fundamental definitions in ANN. Supervised
and unsupervised learning is explained and examples for each of them are provided. Multilayer Perceptron and Back Propagation as a supervised and Self Organized Map as unsupervised learning algorithms and their algorithms are described. In chapter 7, AI which has various applications in medical diagnosis is mentioned. One of the most impressive processing tools is this area is artificial neural network that has improved the performance of the existing diagnosis systems.

The basic definitions in heart studies and the electrocardiogram signals are explained in chapter 8. In addition, the importance of interpretation and measuring the effective features in heart signals to detect the heart disorders is described. Noise removal, feature extraction and optimized approaches for classifications of heart signals are some of the main areas that are explained in chapter 9. In chapter 10, the first stage for detecting heart disorders that is noise removal is explained. Two intelligent approaches based on Self Organizing Map (SOM) and Particle swarm Optimization (PSO) are used to train the feedforward neural network for noise removal. The trained ANNs are used to find the cutoff frequency. Then the found cutoff frequency is applied by a bandpass FIR filter for ECG noise removal.

In chapter 11, the second and the third stages are explained. The Second stage is to extract the effective features of the ECG signals. The final stage is to use MLP and PSO algorithms for classification of ECG signals to detect the 4 common heart disorders including the normal signals. In chapter 12, application of an intelligent system based on artificial neural network for decision making for Hepatitis is investigated.

In chapter 13, the basic definition of Genetic Algorithm (GA) and some of the main operations applied in GA are explained. In addition, Swarm Intelligence (SI) as the new branch of intelligent behavior of nature phenomena is briefly explained. Chapter 14 shows the application of PSO and GA algorithms for training the neural network using two datasets: XOR and Iris. Then the performance of both algorithms are compared and presented by figures. In addition, some of the other optimization algorithms such as Gravitation Search Algorithm (GSA) and Ant Colony Optimization (ACO) are explained. Finally in chapter 15 a brief review on the Netlab toolbox that works with MATLAB software is presented. Some of the main functions are introduced and examples of using the Netlab toolbox are provided to support the explanation.

The valuable aspect of this book is practical applications of ANN in solving various problem. The novel approaches based on ANN are presented and this helps the reader to gain an overview of using ANN. The simple language of book is a distinguishable aspect that is desirable for those who are not professional in ANN based approaches.

*Sara Moein*
*Texas A&M University, USA*
REFERENCES


