Chapter 2
An Intelligent Process Development Using Fusion of Genetic Algorithm with Fuzzy Logic

Kunjal Bharatkumar Mankad
Independent Researcher, India

ABSTRACT

Intelligent System (IS) can be defined as the system that incorporates intelligence into applications being handled by machines. The chapter extensively discusses the role of Genetic Algorithm (GA) in the search and optimization process along with discussing applications developed so far. A very detailed discussion on the Fuzzy Rule-Based System is presented along with major applications developed in different domains. The chapter presents algorithm of implementing intelligent procedure to decide whether a patient is prone to heart disease or not. The procedure evolves solutions using genetic operators and provides its decision automatically. The chapter presents discussion on the results achieved as a result of prototypical implementation of the evolutionary fuzzy hybrid model. The significant advantage of the presented research work is that applications that do not have any mathematical formulation and still demand optimization can be easily solved using the designed approach.

INTRODUCTION

Current scenario of real life applications development is a result of utilizing intelligent techniques provided by soft computing family. The research work focuses on evolutionary computing for searching the optimum solution from global search space. Evolutionary computing provides the way of achieving optimized outcome with less complexity and high accuracy. Due to the above stated qualities, Evolutionary Computing is utilized as major computing approach in search and optimization. Evolutionary Computing has major four constituents such as Genetic Algorithm (GA), Genetic Programming (GP), Evolutionary Programming (EP) and Evolutionary Strategies (ES). Genetic Algorithm is prime constitu-

DOI: 10.4018/978-1-4666-7258-1.ch002

ent of Evolutionary Computing (EC). GA provides efficient search and optimized outcome. But at the same time GA suffers from two major limitations such as lack of domain knowledge representation and handling imprecision and uncertainty. In order to deal with the stated limitations of GA, Fuzzy Logic is hybridized with GA. The chapter proposes machine learning approach using genetic-fuzzy hybridization for medical diagnostic application for heart disease identification. The current research work provides a novel design of genetic-fuzzy hybrid structure for automatic decision support. The chapter presents the design of intelligent procedure that supports genetics based rule learning which integrates linguistic knowledge representation. The chapter presents algorithm of implementing intelligent procedure along with discussion of every steps. The chapter explains different parameters of patent's cardiac profile in order to decide whether patient is prone to heart disease or not. Supervised machine learning is implemented to incorporate medical expert's knowledge into the system. Machine learning is made possible by utilizing the developed intelligent process using Genetic Algorithm and Fuzzy Logic. The research work is based on supervised machine learning approach in which machine is trained through expert's knowledge once, and later on takes decision automatically every time. The outcome provided by Genetic Algorithm is mapped to get automatic decision for real life application. It presents discussion on the results achieved as prototypical implementation of evolutionary fuzzy hybrid model for medical diagnostic application. The significant advantage of the presented research work is that applications which do not have any mathematical formulation and still demands optimization can be easily solved using the designed approach.

The first section of the chapter introduces classification taxonomy of computational approaches. There are two major approaches of computing: Traditional or hard computing and soft computing. The chapter extends the role of soft computing for designing intelligent system for medical diagnosis. The chapter further explains role of Evolutionary computing for search and optimization. The second section of the chapter contains a very detailed discussion on characteristics of classical search and optimization methods. The chapter also discusses various issues in search strategy. The role of Genetic Algorithm is explained along with its general structure. The life cycle of Genetic Algorithm is explained along with discussion of its components. Various steps of Genetic Algorithm are explained in detail. Genetic Algorithm mimics process of natural evolution. Genetic Algorithms have been used for problem-solving for parallel processing, machine learning, evolutionary algorithms, computer games, search and optimization, etc. The chapter also presents detail discussion of real life applications, developed using Genetic Algorithm. These applications include optimization, machine learning, Immune System Models, models of social systems, Automatic Programming, Machine and robot learning, Computer Games, Scheduling Problems etc. The limitations of Genetic Algorithm are narrated which lead to concept of hybridization with Fuzzy Logic. The third section of the chapter explains the role of Fuzzy Logic to handle imprecision and uncertainty. Example wise difference between Boolean (traditional) logic and Fuzzy Logic is presented in this chapter. The chapter also extends the role of membership function in designing fuzzy systems. It discusses Fuzzy Rule Based System is detail. Linguistic knowledge representation is made possible with the theory of Fuzzy Logic. The chapter presents important real life applications developed using Fuzzy Logic. Various limitations of Fuzzy System are presented along with solutions. The forth section of the chapter presents development of intelligent process using genetic fuzzy hybridization. The problem of heart disease diagnosis is discussed. The intelligent procedure is designed to provide outcome whether patient is prone to heart disease or not by observing values of test data. The procedure evolves solutions and provides decision automatically even in absence of medical expert. The result and discussion section represents accuracy and interpretability of the designed intelligent systems. Similar application