Chapter 10
Adaptive Neuro Fuzzy Inference System for Likelihood of Admission to ICU for COVID-19 Patients

ABSTRACT

The analysis of epidemiological data is critical to disease prevention and control programs geared toward improving, promoting, and protecting the health of communities. Various decision-making support systems have been modelled using artificial neural networks and fuzzy inferences. A neuro-fuzzy inference system based on the Takagi-Sugeno system was developed in the early 1990s that integrates the advantages of neural networks with fuzzy logic principles, such as self-learning and knowledge representation. Adaptive neuro-fuzzy inference systems are devised and evaluated here as means of characterizing the severity of a laboratory-confirmed COVID-19 case. The authors describe the underlying architecture for ANFIS with various clustering approaches, including grid partitioning, subtractive clustering, and fuzzy c-means. A total of 385 cases with eight potential predictors is used to develop, validate, and evaluate the model.

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INTRODUCTION

In a worldwide effort to understand the nature of the pandemic, researchers are using a variety of approaches, including mathematical and machine learning models to understand the disease's nature and provide the authorities with the information they need. Since the first patient was hospitalized on December 12, 2019, there have been 19,634,028 cases, out of which 12,615,278 patients have recovered and 725,788 people have died. To deal with the current epidemic situation, an adaptive neuro fuzzy system is presented that combines fuzzy logic and neural networks. Information is gathered from interconnected data through artificial neural networks, where input and output data are strategically arranged through highly interconnected processing. However, neural networks have some shortcomings when it comes to represent implicit knowledge. A fuzzy logic system can be used to create models that adapt to uncertainties in data, but is subjective and heuristic. Furthermore, Fuzzy Logic systems must be designed by trial and error method to determine fuzzy rules, inputs, and outputs; this requires a considerable amount of time. A combination of neural networks and fuzzy logic may thus be the optimal choice to model the data in order to ensure maximum information is gathered from the data. By integrating Neural Network technology with Fuzzy Logic called Adaptive Neuro Fuzzy Inference System (ANFIS), we can reverse the drawbacks of Neural Network and Fuzzy Logic systems. The most significant advantage of using ANFIS is that all its parameters can be trained like a Neural Network within the structure of a Fuzzy Logic system. ANFIS uses a hybrid learning algorithm to identify the parameters of the membership functions of single-output Sugeno type fuzzy inference systems. In order to train FIS membership function parameters, a combination of least-squares and backpropagation gradient descent methods is employed to model a set of input/output data. ANFIS are a class of adaptive networks that are functionally equivalent to fuzzy inference systems by using Sugeno Tsukamoto fuzzy models and hybrid learning algorithms. In recent years, ANFIS has drawn attention for its ability to create intelligent methods. With the ANFIS method, it comes with the advantage of how it combines both positive features and it leads to producing a more reliable program for improving the performance of systems to serve several purposes.

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