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Review on Soft Computing in Data Analysis

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Abstract

The ability to access, store, and process enormous volumes of data has significantly expanded due to technological advancements in computation, data storage, networks, and sensors. Large-scale data processing is becoming an increasingly important thing for both research and business. Clients, who are typically domain experts, face an enormous challenge and require assistance in handling huge amount of data's. Soft computing can indeed be characterised as a science of thought and logic that aids in navigating complex systems. This article is about the use of soft computing techniques to support data analysis in an intelligent manner.

Keywords: Data storage, data processing, soft computing, data mining, data analysis

1. Introduction

Data analysis aims to use this data and transform it into knowledge that will aid in decision-making. The traditional approach to data analysis relies on statistics, but when data volumes increase or when real-time data processing is required, the necessity for advances in computational analysis approaches increases [1]. Big data and virtualization are having a significant impact on international trade and the global economy, and soft computing is one of the key factors advancing industrial classification, prediction, and bettering human existence [2]. When compared to conventional hard computing, soft computing is nearer to the objective things themselves and uses human thinking more intelligently to complete the problem's solution. Soft computing is primarily composed of rough sets, fuzzy logic, neural networks, genetic algorithms, particle swarm algorithms, chaos, and other parts .

A dataset's additional value comes from the information of a domain expert Effective techniques must be developed in order to provide meaningful, condensed, and human-interpretable representations of large datasets, given the continuously rising

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volume and variety of these datasets[3]. Algorithms for soft computing have proven to be useful for effectively analysing massive data sets.

This below article summarizes soft computing and related techniques in Section 2. Related works on soft computing applications in Section 3.In Section 4, finally the conclusion of the study.

2. Soft Computing Techniques

Optimization issues have traditionally been solved using soft computing techniques. Numerous domains offer genuine issues that are, at least theoretically speaking, challenging to resolve; as a result, soft computing is ideal for reasonably accurate prediction [4].

Diverse soft computing strategies are used to train these systems. Soft computing techniques include:

- Fuzzy logic
- Evolutionary computing
- Artificial intelligence

2.1 Fuzzy logic

Fuzzy logic (FL) is particularly interested in imprecision and approximate reasoning, while neuro computing, genetic computation and probabilistic reasoning are more interested in uncertainty and belief propagation. Complementary rather than competitive, are the soft computing's components [5][20].

The architecture comprises of four phases as in figure 1:

a) Rule based: It includes the collection of guidelines and IF-THEN conditions offered by the specialists to control the system for making decisions based on linguistic data. Numerous efficient techniques for designing and fine-tuning fuzzy controllers are now available because of the recent advancements in fuzzy theory. The majority of these innovations lower the quantity of fuzzy rules.

b) Fuzzification: It transforms inputs, such as sharp numbers, into fuzzy sets. Crisp inputs, which include temperature, pressure, rpms, and other precise inputs, are basically the measurements made by sensors and sent to the controller system for processing

c) Inference engine: As per the input field, it determines which rules should be fired and the degree to which the present fuzzy input matches each rule. The control actions are then created by combining the fired rules.

d) Defuzzification: The inference engine's fuzzy sets are transformed into crisp values using it. Numerous defuzzification techniques exist, and the most effective one is combined with a particular expert system to minimise the error.

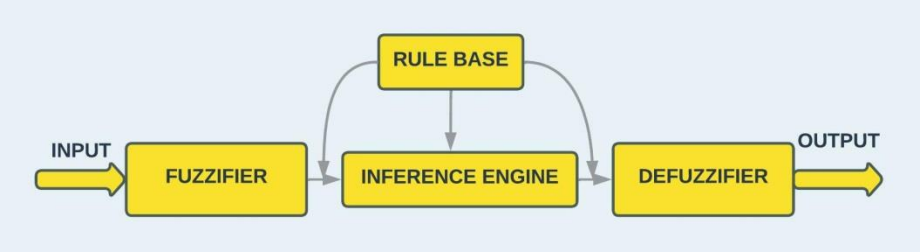

Figure 1. Fuzzy logic architecture

2.2 Evolutionary computing

Researchers dealing with tough optimization problems can benefit practically from evolutionary computation. These benefits come in numerous forms, including the method's versatility, adaptability, and robust reaction to shifting conditions [6]. It contains genetic algorithms that are based on natural selection. A population of individuals is used in Genetic Algorithm(GA), an optimization approach, but each individual is referred to as a chromosome[19].The below figure 2 is the process flow chart of GA structure.

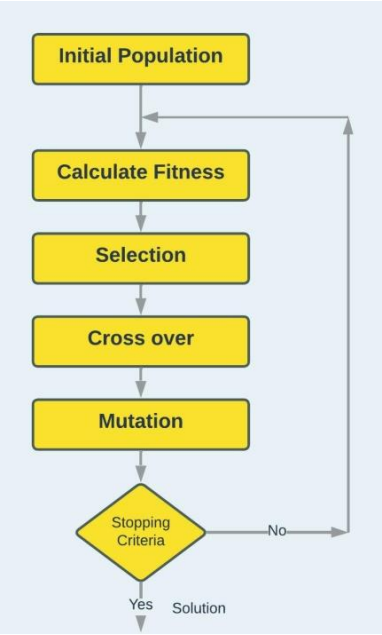

Figure 2. Genetic algorithm process flow

2.3 AI on soft computing

Neuro computing is the study of a network of interconnected nodes known as neurons. AI is a computational technology that draws inspiration from the biological nervous system[7]. There are three layers total: input, hidden, and output as in figure 3. These layers, which are composed of neurons, are linked by weights. Using comparable tools, soft computing addresses issues in the real world [16-18]. AI frequently uses human-like solutions to issues like gaming, perception, and conversation.

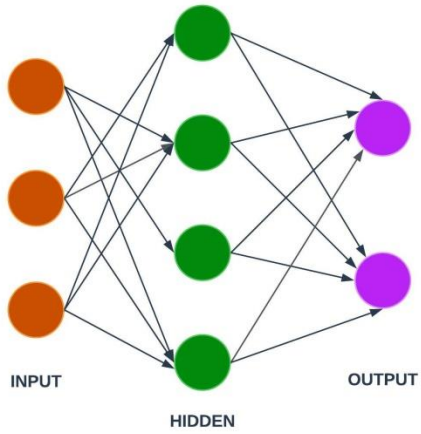

Figure 3. Structure of ANN

3. Related Work

3.1 Health Care

The most common and widespread psychological state that unavoidably affects people's mood and conduct is stress. The contributions, benefits, and difficulties associated with integrating supervised learning model and soft computing technique approaches into stress diagnostic models have all been carefully examined. In this article, various forms of data/signals have been employed in stress diagnosis, including skin temperature, heart rate, blood circulation, electro-dermal activity, and facial expressions using hybrid computational methods that are based on models and are affected from both AI and soft computing approaches [8].

In this article, EMG signals automatically divided into three categories: normal, neurogenic, and myopathy. Additionally, the classification accuracy of classifiers based on dynamic fuzzy neural networks (DFNN), multilayer perceptron neural networks (MLPNN), and adaptive neuro-fuzzy inference systems (ANFIS) was compared. According to the

comparison research, the ANFIS model is better to the MLPNN and DFNN in three ways: it has a higher recognition rate, is less sensitive to overtraining, and consistently produces reliable results [9].

3.2 Robotics

To obtain accurate traffic-level measures, safeguard the performance of a Web server and maintain the privacy of any data on it, an effective detection of web robot activities from a web server log is necessary. This paper introduces SMART, soft computing framework which can automatically update to the session features of a web server while concurrently detecting benign and harmful forms of robot agent from web server logs [10].

A difficult area of research is identifying human intentions from trajectory data in the context of human-robot interaction. In this paper, the scheduling of the information flow is explored along with certain control problems with human-robot communication and respective goals to collaborate or compete in shared workspaces. The detection of membership degrees of a pedestrian path to particular lanes, the recognition of human intentions to proceed to such goals, pedestrian track are modelled by fuzzy clustering algorithm, lanes chosen by human agents are recognized [11].

3.3 Field of Civil Engineering

When constructing civil engineering structures that are anchored in the ground, the coefficient of condensation (Cv) is a crucial factor. Efforts have been done to associate the Cv with the index qualities of soil because it is difficult to determine the Cv in a lab setting. The Cv of soft soil was predicted quickly and accurately in this study using a variety of advanced soft computing methods, including Support Vector Machines (SVM), Adaptive Network based Fuzzy Inference System (ANFIS), Artificial Neural Networks (ANN), and Biogeography-Based Optimization based Machine Learning Techniques (ANN-BBO) [12].

3.4 Data Mining

There is a lot of data production and transport happening every day. The nature of this data can be static, dynamic, or transactional. It becomes necessary to investigate and learn from the recently introduced data. The current study analyses the optimum crop production by using the proposed method of decision tree for reducing data dimensional for carrying out the various data processing operations including machine learning algorithms, data mining, pattern classification, and find the proper effect and weather situation (DT)[13].

3.5 Crime Forecasting

In order to improve comprehension, processing speed, and effectiveness of the crime investigations, forensic science needs increasingly sophisticated data analysis tools. This is largely a consequence and variety of crimes increasing. By adopting imperfect solutions and models that are easy for humans to understand, soft computing techniques have already demonstrated their effectiveness and can facilitate greater cooperation between forensic analysts and computational intelligence scientists. There are a number of methods for storage and mining massive amounts of data, such that analytical techniques like Mahout, MLBase, and Spark.data are still insufficient for forensic science and big data [14].

3.6 Smart Transportation

Due to the extent of the acquired dynamic car flow data, to regulate the traffic signals effectively. In this paper, introduce NeverStop, a big data smart transport system that makes use of evolutionary computation and fuzzy control techniques. NeverStop is built with sensors to automatically control the traffic signals at intersections. The average waiting period can be greatly decreased by adjusting the waiting period for such traffic lights using the fuzzy control approach and genetic algorithm [15].

4. Conclusion

The application of soft computing approaches to data analysis across a variety of domains facilitates the quick and simple making of well-informed decisions. The choice of an effective algorithm for data analysis is a difficult process because it calls for number of factors including cost, efficiency, accuracy, fault tolerance, and others. This paper envelops variety of soft computing methods utilised in many fields and their benefits over more conventional approaches.

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