ARTIFICIAL NEURAL NETWORKS: A STUDY

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Abstract

An Artificial Neural Network (ANN) is an information processing paradigm that is inspired by the way biological nervous systems, such as the brain, process information. The key element of this paradigm is the novel structure of the information processing system. It is composed of a large number of highly interconnected processing elements (neurons) working in unison to solve specific problems. ANNs, like people, learn by example. An ANN is configured for a specific application, such as pattern recognition o r data classification, through a learning process. Learning in biological systems involves adjustments to the synaptic connections that exist between the neurons. This is true of ANNs as well. This paper gives overview of Artificial Neural Network, working & training of ANN. It also explains the application and advantages of ANN. The coupling of computer science and theoretical bases such as nonlinear dynamics and chaos theory allows the creation of 'intelligent' agents, such as artificial neural networks (ANNs), able to adapt themselves dynamically to problems of high complexity. ANNs are able to reproduce the dynamic interaction of multiple factors simultaneously, allowing the study of complexity; they can also draw conclusions on individual basis and not as average trends. These tools can offer specific advantages with respect to classical statistical techniques. This article is designed to acquaint gastroenterologists with concepts and paradigms related to ANNs. The family of ANNs, when appropriately selected and used, permits the maximization of what can be derived from available data and from complex, dynamic, and multidimensional phenomena, which are often poorly predictable in the traditional 'cause and effect' philosophy.

Paper Identification

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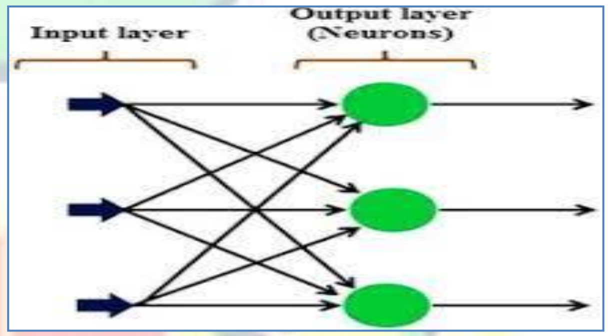
Introduction

The study of brain is an interesting area since a long time. With advancement in the field of electronics and computer science, it was the assumed that we can use this natural way of this thinking process of brain to design some artificial intelligence system. The first step toward artificial intelligence came into existence in 1943 when Warren McCulloch, a neurophysiologist, and a mathematician, Walter Pitts, wrote a paper on how neurons work. Mathematical analysis has solved some of the mysteries posed by the new models but has left many questions for future investigations. There is no need to say, the study of neurons, their interconnections, and their role as the brain's elementary building blocks is one of the most dynamic and important research fields in modern world of electronics and computer science.

The coupling of computer science and theoretical bases such as nonlinear dynamics and chaos theory allows the creation of 'intelligent' agents, such as artificial neural networks (ANNs), able to adapt themselves dynamically to problems of high complexity. ANNs are able to reproduce the dynamic interaction of multiple factors simultaneously, allowing the study of complexity; they can also draw conclusions on individual basis and not as average trends. These tools can offer specific advantages with respect to classical statistical techniques. This article is designed to acquaint gastroenterologists with concepts and paradigms related to ANNs. The family of ANNs, when appropriately selected and used, permits the maximization of what can be derived from available data and from complex, dynamic, and multidimensional phenomena, which are often poorly predictable in the traditional 'cause and effect' philosophy.

Artificial neural networks are increasingly used in the control or modeling of systems that have unknown or very complex internal structures. For example, a neural network can be used to control the input of an engine, in which case the neural network itself will learn the control function. Learning in these systems is adaptive, that is, using parables, the weight of the synapses changes in such a way that the system produces the correct response if new inputs are given (Wu and Feng 2018). A neural network is given a set of inputs and their corresponding outputs when it is being trained.

There are two Artificial Neural Network topologies as FeedForward and Feedback. In the feed forward systems, there are no feedback loops, because a unit sends information to another unit from which it receives none. Inputs and outputs are fixed. Each unit receives input information from its units on the left, and the inputs are multiplied by the weight of each connection. So, the output results related to the weight of each connection can be obtained. Pattern generation, identification, and classification are some application of the method. The system is applied to the network applications when already know what outcome of the network is required to be achieved (Al-Zewairi, Almajali, and Awajan 2017). Many commercial applications, such as computer vision, are built on this foundation. The architecture of Feed Forward Neural Network topologies systems are shown in the figure below:



In the FeedBack ANN systems, content addressable memories are used. Learning neural networks using a feedback process is by comparing the output of a network with the output that is desired and expected. The difference between these two outputs is used to change and modify the weights of the connections between the network units.

ANN - Training

An ANN has to be designed and implemented in a way that the set of input data results into a desired output (either direct or by using a relaxation process). Several methods to quantify the strengths of the connections can be applied. In other words, the weights can be set explicitly (utilizing a priori knowledge) or the net can be trained by feeding learning patterns into the solution, and by letting the net change/adjust the weights according to some learning rule. Learning based solutions can be categorized as:

Supervised or associative learning Where the net is trained by quantifying input, as well as matching output patterns. These input/output pairs are either provided by an external teaching component or by the net itself also known as self-supervised approach.

Unsupervised learning (self-organizing paradigm) where the net (output) unit is trained to respond to clusters of pattern within the input framework. In this paradigm, the system is supposed to discover statistically salient features of the input population. Compared to the supervised learning method, there is no a priori set of categories into which the patterns are to be classified; rather the system has to develop its own representation of the input stimuli.

Reinforcement Learning In this method, the learning machine executes some action on the environment, and as a result, receives some feedback/response. The learning component grades its action (as either good or bad) based on the environmental response, and adjusts its parameters accordingly. Generally speaking, the parameter adjustment process is continued.

Advantages of Neural Network

There are various advantages of neural networks, some of which are discussed below:

1) **Store information on the entire network**- Just like it happens in traditional programming where information is stored on the network and not on a database. If a few pieces of information disappear from one place, it does not stop the whole network from functioning.

2) **The ability to work with insufficient knowledge**- After the training of ANN, the output produced by the data can be incomplete or insufficient. The importance of that missing information determines the lack of performance.

3) **Good fault tolerance**-The output generation is not affected by the corruption of one or more than one cell of artificial neural network. This makes the networks better at tolerating faults.

4) **Distributed memory**- For an artificial neural network to become able to learn, it is necessary to outline the examples and to teach it according to the output that is desired by showing those examples to the network. The progress of the network is directly proportional to the instances that are selected.

5) **Gradual Corruption**- Indeed a network experiences relative degradation and slows over time. But it does not immediately corrode the network.

6) **Ability to train machine**- ANN learn from events and make decisions through commenting on similar events.

7) **The ability of parallel processing**- These networks have numerical strength which makes them capable of performing more than one function at a time.

Limitations of Neural Network

In this world everything has some merits and demerits, so the neural network system also has some merits and demerits. The limitations of ANN are:

1. ANN or Neural Networks is not a daily life problem solver.
2. There is no structured methodology available.
3. There is no single standardized paradigm for Neural Networks development.
4. The Output Quality of an ANN can be unpredictable.
5. Many ANN Systems does not describe how they solve the problems.
6. Nature of ANN is like a Black box.

Applications

The real time applications of Artificial Neural Networks are:

1. Functional approximation, including time series prediction and modeling.
2. Call control- answer an incoming call (speaker-ON) with a swipe of the hand while driving.
3. Classification, including pattern and sequence recognition, pattern detection and sequential decision making.
4. Skip tracks or control volume on your media player using simple hand motions
5. Data processing, including filtering, clustering, blind signal separation and compression.

6. Scroll Web Pages, or in an eBook with simple left and right hand gestures, this is ideal when touching the device is a barrier such as wet hands are wet, with gloves, dirty etc.

7. Application areas of ANNs include system identification and control.

Conclusion

An artificial neural network (ANN) is made up of artificial neurons, which are a series of linked units or nodes that resemble the neurons in a biological brain. Each link, similar to synapses in a biological brain, has the ability to send a signal to other neurons. Adaptive learning is the most important advantages of the ANNS systems. The learning rate determines how large the model's corrective steps are in adjusting for errors in each observation. A high learning rate reduces training time but reduces overall accuracy, while a low learning rate takes longer but has the potential for greater accuracy. Although ANNs can handle most tasks if they are given the opportunity to prepare for them, the biggest challenge is the time it takes to train them and the computing power needed for a complex task. Performance of an ANN models in the complex problems strongly depends on the network architecture in order to achieve the best solutions for the simulated challenges. When dealing with large datasets, neural networks are extremely useful. ANNs can run much faster than their linear counterparts when dealing with massive, continuous streams of data, such as speech recognition or computer sensor data. This means that the neural network has enough data to generate mathematical models of the data that has been inputted; this is why, with the amount of new data coming out every year, they are becoming more and more popular.

Self-driving vehicles, character recognition, image compression, stock market prediction, risk analysis

Systems, drone control, welding quality analysis, computer quality analysis, emergency room testing, oil and gas exploration and a variety of other application all use artificial neural network.

Since the inception of AI research midway through the last century, the brain has served as the primary source of inspiration for the creation of artificial systems of intelligence. This is largely based upon the reasoning that the brain is proof of concept of a comprehensive intelligence system capable of perception, planning, and decision making, and therefore offers an attractive template for the design of AI. In this review, based upon topics presented at the 2020 International Symposium on Artificial Intelligence and Brain Science, we have discussed how brain-inspired mechanistic, structural, and functional elements are being utilized to create novel, and optimize existing, AI systems. In particular, this has led to the development of high-dimensional deep neural networks often incorporating hierarchical architectures inspired by those found in the brain and capable of feats of intelligence including visual object recognition and memory-based cognitive tasks. Advancements in AI have also helped to foster progress within the field of neuroscience. Here we have described how the use of machine learning and neural networks for automated analysis of big data has revolutionized the analysis of animal behavioral and and neuroimaging studies as well as being utilized for objectives classification of psychiatric and developmental disorders.

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