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Implementation of Bioinformatics for the study of Neurological diseases based on ANN (Artificial Neural Network) using TAU protein

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Abstract

ANN (Artificial Neural Network) generally referred as neural networks are the information or signal processing mathematical model that is basically based on biological neurons. It is a complex structure which consist of a group of interconnected neurons which provides a very exciting alternatives for complex problem solving and other application which can play important role in today's advancement of technology and computer world, so scientist and researcher from different streams are planning and designing the ANN to solve the problems for pattern recognition, sequence and structure prediction, optimization, associative memory and there control.

In this paper we have presented the basic study of the artificial neural network, its application and advantages also tried to study the GEO dataset based on neurological disease associated protein TAU and its relation to CNS central nervous system, also how the layers develop and signal processing takes place.

Keywords: ***Neural Network, Neuron, Tau, NCBI GEO Dataset, Bioinformatics.***

1. Introduction

A neural network is an interconnected assembly of simple processing elements, *units* or *nodes*, whose functionality is loosely based on the animal neuron. The processing ability of the network is stored in the inter unit connection strengths, or *weights*, obtained by a process of adaptation to, or *learning* from, a set of training patterns.

1.1 What is a Neural Network

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 or 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.

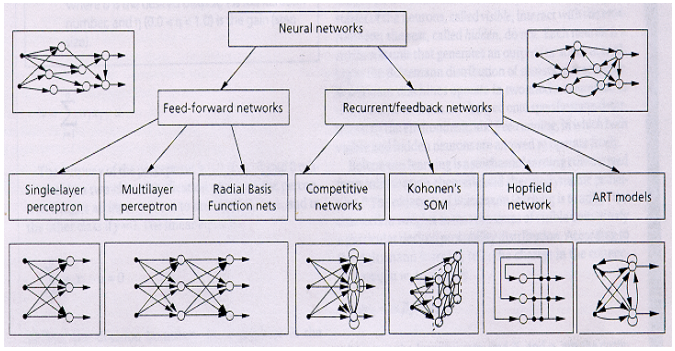

Fig: 1 Simple Neural Network

1.2. Type of neural network

Neural networks have the unique ability to derive meaning from complex and imprecise data. Neural networks can easily extract trends and patterns that are way too complicated for humans or other computer techniques to extract. Neural networks that are thoroughly trained can be thought of as 'experts' in the areas of information that have been given to them for analysis.

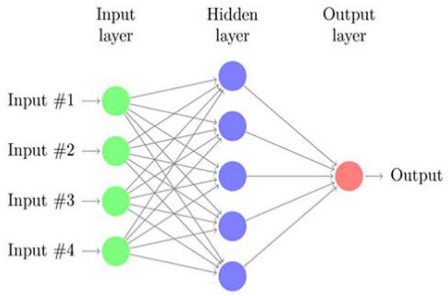

Fig:.2 Multilayer Artificial Neural Network

1.3 FEED forward Neural Network

The simplest of all neural networks, the feed forward neural network, moves information in one direction only. Data moves from the input nodes to the output nodes, passing through hidden nodes (if any). The feed forward neural network has no cycles or loops in its network.

1.4 Radial Basis Function Neural Network

The RBF neural network is the first choice when interpolating in a multidimensional space. The RBF neural network is a highly intuitive neural network. Each neuron in the RBF neural network stores an example from the training set as a "prototype". Linearity involved in the functioning of this neural network offers RBF the advantage of not suffering from local minima.

1.5 Kohonen Self-Organizing Neuralnetwork

Invented by Teuvo Kohonen, the self-organizing neural network is ideal for the visualization of low-dimensional views of high-dimensional data. The self-organizing neural network is different from other neural networks and applies competitive learning to a set of input data, as opposed to error-correction learning applied by other neural networks. The Kohonen self-organizing neural network is known for performing functions on unlabeled data to describe hidden structures in it.

1.6 Recurrent Neural Network

The recurrent neural network, unlike the feed forward neural network, is a neural network that allows for a bi-directional flow of data. The network between the connected units forms a directed cycle. Such a network allows for dynamic temporal behavior to be exhibited. The recurrent neural network is capable of using its internal memory to process arbitrary sequence of inputs. This neural network is a popular choice for tasks such as handwriting and speech recognition.

1.7 Modular Neural Networks

This interesting neural network comprises of a series of independent neural networks that are moderated by an intermediary. Each of these independent neural networks works with separate inputs, accomplishing subtasks that make up the task the network as whole hopes to perform. The intermediary accepts the inputs of each of these individual neural networks, processes them, and creates the final output for the modular neural network. The independent neural networks do not interact with each other.

1.8 Physical Neural Network

This neural network aims to emphasize the reliance on physical hardware as opposed to software alone when simulating a neural network. An electrically adjustable resistance material is used for emulating the function of a neural synapse. While the physical hardware emulates the neurons, the software emulates the neural network.

2. Main architecture of Artificial Neural Network

In general, an artificial neural network can be divided into three parts, named layers, which are known as: (a)

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Input layer This layer is responsible for receiving information (data), signals, features, or measurements from the external environment. These inputs (samples or patterns) are usually normalized within the limit values produced by activation functions. This normalization results in better numerical precision for the mathematical operations performed by the network.

(b) Hidden, intermediate, or invisible layers These layers are composed of neurons which are responsible for extracting patterns associated with the process or system being analyzed. These layers perform most of the internal processing from a network.

(c) Output layer This layer is also composed of neurons, and thus is responsible for producing and presenting the final network outputs, which result from the processing performed by the neurons in the previous layers. The main architectures of artificial neural networks, considering the neuron disposition, as well as how they are interconnected and how its layers are composed, can be divided as follows:(i) single-layer feed forward network, (ii) multilayer feed forward networks.

3. Tau

Tau proteins (figure 3) are proteins that perform the function of stabilizing microtubules. These proteins are abundant in nerve cells and are present to a much lesser degree in oligodendrocytes and astrocytes. The tau proteins are the product of alternative splicing from a single gene that in humans is designated MAPT (microtubule-associated protein tau) and is located on chromosome 17. Tau proteins are mainly active in the distal portions of axons where they stabilize microtubules as well as providing flexibility. The proteins work together with a globular protein called tubulin to stabilize microtubules and aid the assembly of tubulin in the microtubules.

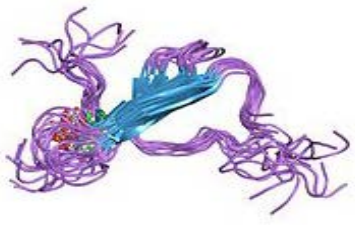
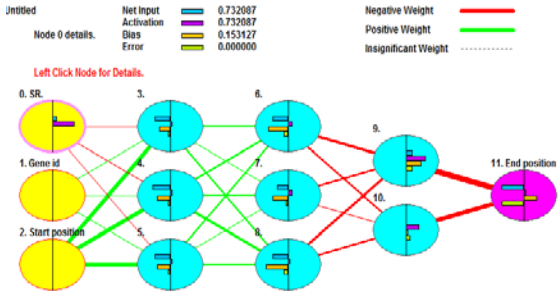


Figure 3:- 3D Strucutre of MAPT (Microtubule associated protein tau)

4. Methodology

GEO (gene expression omnibus) datasets have been used for the said study, datasets have been shortlisted based on the criteria of TAU protein (found abundantly in neurons as compare to elsewhere in the body), also associated with Alzheimer's and Parkinson's Diseases. These datasets have been extracted from NCBI GEO and sorted according to the requirement of the application used for Neural Network Construction (JNN) (figure 4), which provides the connection between input layer and output layer and signal flow of from input to output using the hidden layers, also the energy level (i.e. minimum, optimum, maximum) (figure 5) in graphical format which shows how energy level increases or decreases at regular interval if level changes.

A. Figures and Tables



Fig

Figure 4 :- JNN showing input layer, output layer, and hidden layer of neural network of TAU.

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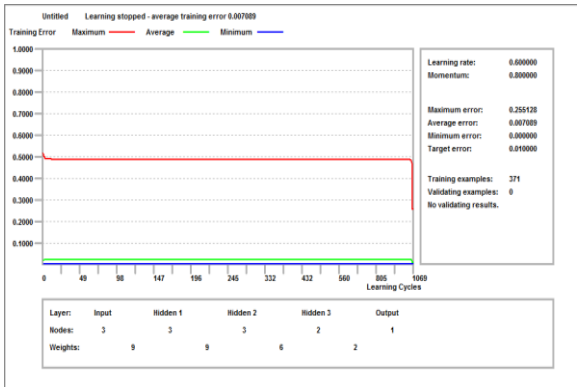

Figure 5: shows energy level maximum, optimum, minimum.

Advantages of ANN

Various applications are available of ANN

a) Self organization: A neural Network can create its own representative.

b) RTO: Real Time Operations, in ANN computations can be carried out parallelly.

c) Pattern Recognition: one of the powerful technique, which helps for data security, which helps to learn to recognize the patterns if exist in data set.

d) Neural network are flexible in a changing environment.

e) ANN can build informative models whenever conventional approaches fail, because neural networks capable to handle complex interactions which can be easily model, which is difficult and tedious if processed with traditional approaches.

Limitations

There are some demerits of ANN which are as follows:

a) ANN or neural networks is not a daily life problem solver.

b) There is no structured methodology available.'

c) There is no single standard parameter/protocol for neural development.

d) Description of problem solving method is not available.

Application of ANN

a) Call control: answer the incoming call with a swipe of hand while driving.

b) Data pre-processing including filtering, clustering, blind signal separation and compression.

c) Classification, including pattern and sequence recognition, pattern detection, and sequential decision making.

5. Result

Obtained output as shown on figure 4 & figure 5, the sorted data of NCBI GEO dataset gives the 3 layer (Input, Hidden, and output) shows the transfer of signal from one end to another with minimum to maximum energy levels, which leads to the optimum path which has to follow to transfer the signals (messages) from one cell to another. For this process the sorted data which was utilised was of GENEID and the length of the gene sequences co-associated with neurological diseases (Parkinson's and Alzheimer's).

6. Conclusion

In this research work we tried to explore and study the horizon of ANN (Artificial Neural Network), how it works, its advantages, limitations, and application of the topic.

There are various advantages of ANN over conventional approaches, depending on the nature of the data patterns which can generally expect a network. Which leads to solve the problem to conclude the relationships by dynamic or non linear one.

By exploring ANN we had concluded that as the technology is increasing the need of ANN is also improving because of parallel processing. Parallel processing allows us to proceed for multi tasking, which is in need due to advancement of technology.

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For future it is need to develop algorithms and programs used for the study of ANN and make it more and more useful for the various kind of applications.

7. References

[1]. David A. Medler "A Brief History of Connectionism" (PDF). Neural Computing Surveys. (1998).

[2]. McCulloch, Warren; Walter Pitts "A Logical Calculus of Ideas Immanent in Nervous Activity". Bulletin of Mathematical Biophysics. (1943).

[3]. An introduction to neural computing. Aleksander, I. and Morton, H. 2nd edition (1955).

[4]. P. J. Werbos. Generalization of backpropagation with application to a recurrent gas market model. Neural Networks, 1, 1988.

[5]. David E. Rumelhart; Geoffrey E. Hinton; Ronald J. Williams. Learning Internal Representations by Error Propagation. 1990.

[6]. A. J. Robinson and F. Fallside. The utility driven dynamic error propagation network. Technical Report CUED/F-INFENG/TR.1, Cambridge University Engineering Department, 1987.

[7]. R. J. Williams and D. Zipser. Gradient-based learning algorithms for recurrent networks and their computational complexity. In Back-propagation: Theory, Architectures and Applications. Hillsdale, NJ: Erlbaum, 1994.

[8]. Haykin, Simon. Neural Networks and Learning Machines. Englewood Cliffs, NJ: Prentice Hall, 2011.

[9]. Gurney, Kevin. An Introduction to Neural Networks. London, England: UCL Press, 1997.

[10]. Rojas, Raúl. Neural Networks: A Systematic Introduction. Berlin: Springer Verlag, 1996.

[11]. Hassoun, Mohamad. Fundamentals of Artificial Neural networks. Boston, MA: MIT Press, 1994.

[12]. Artificial Neural Networks da Silva, I.N., Hernane Spatti, D., Andrade Flauzino, R., Liboni, L.H.B., dos Reis Alves, S.F.

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