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INTELLIGENT SYSTEM OF NEURAL NETWORK FOR HEART DISEASES PREDICTION

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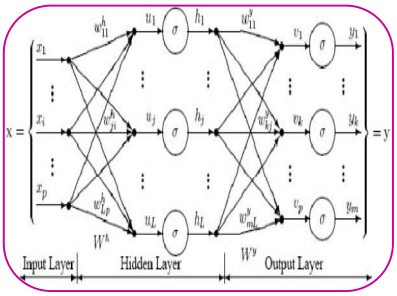
ABSTRACT:

Diagnosing heart disease has become a difficult task in the field of medicine. This diagnosis depends on a thorough and accurate study of the patient's clinical examination data on a person's health history. Tremendous improvements in the field of machine learning are aimed at developing intelligent automated systems that help medical professionals predict disease as well as make decisions. Such an automated system for medical diagnosis will enhance timely medical care followed by appropriate treatment which will save significant lives. Inclusion of classification techniques in these intelligent systems leads to accurate diagnosis. Neural networks have emerged as an important classification method. A multi-layer perceptron neural network with back-propagation is used as the training algorithm in this work.

KEY WORDS: Architecture deals, society, organization, technology and humanity.

INTRODUCTION:

One of the most important organs in the human body is the heart and its function is to pump blood to almost every part of the human body and thus supply oxygen to those parts. Thus, the action of the heart is undoubtedly responsible for life. In a normal person, the heart beats with a regular rhythm and a specific pattern. In fact, the pumping action of the heart is attributed to electrical impulses generated within the heart and carried along the different parts of the heart. This electrical activity of the heart can be detected as an electrical signal from the surface of the skin. This study is known as electrocardiography and the captured signal is called electrocardiogram/ECG. Thus, an electrocardiogram provides important information about the electrical activity of the heart and thus its medical condition. Electrocardiography is undoubtedly the best and easiest method to study the heart and its physiology. Einthoven has been used by cardiologists for eight years. Numerous cardiac problems are directly related to this area in terms of visible lesions in the ECG. According to statistics recently released by the World Health Organization, cardiovascular disease (CVD) kills approximately 20 million people every year. This suggests that CVD is a major cause for concern and that more thought is needed on how to reduce these statistics in the future. It has been suggested that the development of new techniques for early diagnosis of potentially life-threatening heart conditions will limit many deaths. Heart failure and attacks can occur for a variety of reasons, many of which can now be prevented and treated. There are many forms of CVD, with coronary heart disease leading to stroke and most deaths.



ARTIFICIAL NEURAL NETWORK:

Artificial neural networks (ANNs), commonly called simply neural networks (NNs) or, more simply, neural nets, are computational systems inspired by the biological neural networks that make up the animal brain. An ANN is based on a collection of connected units or nodes called artificial neurons, which model neurons in a biological brain. Each connection, like a synapse in a biological brain, can transmit signals to other neurons. An artificial neuron receives and processes signals and can signal neurons connected to it. The "signal" at the connection is a real number, and the output of each neuron is measured by some non-linear function of the sum of its inputs. The joints are called edges. Neurons and edges typically have weights that adjust during learning. The weight on the connection increases or decreases the signal strength. Neurons may have a threshold such that a signal is sent only if the overall signal exceeds that threshold. Normally, neurons are grouped into layers. Different layers can perform different transformations on their inputs. Signals travel from the first layer (input layer) to the last layer (output layer), possibly after going through the layers several times.

BIOLOGICAL AND ARTIFICIAL NEURONS:

The human brain provides evidence for the existence of multiple neural networks that can perform cognitive, cognitive, and control tasks in which humans succeed. The brain is capable of demanding computer-sensitive actions and control activities. The brain's advantage is its extensive parallelism, highly parallel computer architecture, and effective use of precise information capabilities. The human brain is a collection of over 10 billion interconnected neurons. Each neuron is a cell that uses biochemical reactions to receive, process, and transmit information.

1. Biological Neuron:

Biological neuron models, also known as speaking neuron models, are mathematical descriptions of the properties of specific cells in the nervous system that produce sharp electrical impulses within their cell, usually in millisecond intervals, called pot action potentials or spikes. Since spikes are transmitted along the synapses of axons and many other neurons that transmit, spiking neurons are considered a major information processing component of the nervous system. Speaking neuron models can be divided into different categories: the most detailed mathematical models are biophysical neuron models that describe membrane voltage as a function of input current and activation of ion channels. There are mathematically simple integrate-and-fire models that describe membrane voltage as a function of input current and predict spike timing without describing the biophysical processes underlying the action potential. Other abstract models predict output spikes only as a function of stimulation where stimulation can occur via sensory input or pharmacologically. This article provides a brief overview of different speaking neuron models and links, whenever possible, to an experimental program. These include deterministic and probabilistic models.

The cell body of a neuron is connected to another neuron by dendrites and communicates via an axon. A group of these neurons form a layer and the collection of these layers forms the nerves in the human body. That is, the dendrites of neurons in the brain tissue nervous system receive signals from other neurons. Signals are electrical impulses that are transmitted across the synaptic cleft through a chemical process. A chemical transmitter changes the incoming signal. The cell body summarizes incoming signals. If the neuron receives enough input, the cell fires. That is, it transmits signals from its axis to other cells. This is a continuous process in the nervous system. This system is able to learn, remember and generate outputs corresponding to external signals. If a system of neurons has a consistent and frequent external signal, its output signal will be coherent and thus it will be remembered or stored in the system. On the other hand, if they cling to inconsistent or rare signals, the memory of this type of information may be lost after receiving other signals or patterns. These biological neuron systems can work together to address more complex learning by explaining how mathematical operations are used to simulate large biological tasks.

2. Artificial Neuron:

An artificial neuron is a connection point in an artificial neural network. Artificial neural networks, like the biological neural networks of the human body, have a layered architecture and each network node (connection point) has the ability to process inputs and forward them to other nodes in the network. In both synthetic and biological architectures, nodes are called neurons and are represented by synaptic weights indicating the importance of connections. As new data is received and processed, synaptic weights change and so does learning. Artificial neurons are modeled after the hierarchical arrangement of neurons in biological sensory systems. In the visual system, for example, light is input through neurons in the layers behind the retina before reaching neurons in the brain's thalamus and then neurons in the brain's visual cortex. As the neurons pass through increasing layers of signals, the brain gradually extracts more information until it is sure that the person can recognize what they are seeing. In artificial intelligence, this fine-tuning process is known as deep learning. In both artificial and biological networks, when neurons process the input they receive, they decide whether to send the output as input to the next layer. The decision whether to send information to it or not is called the bias and is determined by the activation function built into the system. For example, an artificial neuron can only send an output signal to the next layer if its inputs add a value greater than a certain threshold value. Activation functions can be either linear or non-linear, so neurons have a wide range of fusion and divergence. Divergence is the ability of a neuron to communicate with many other neurons in the network, and conversion is the ability of a single neuron to receive input from many other neurons in the network.

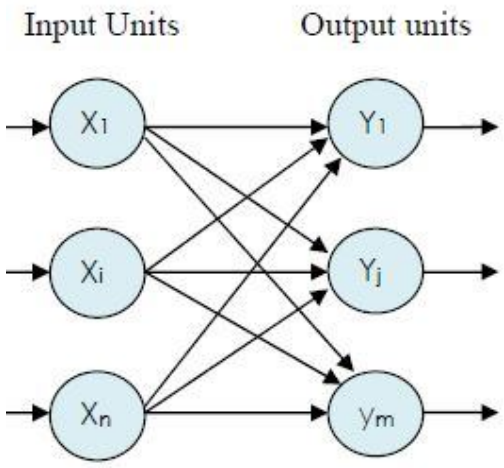
NEURAL NETWORK ARCHITECTURE:

A neural network is a complex structure made up of artificial neurons that can take multiple inputs to produce a single output. The primary function of a neural network is to convert input into meaningful output. Usually, a neural network consists of input and output layers with one or more hidden layers. In a neural network, all neurons communicate with each other and are therefore interconnected. A network can manually identify and observe each element of a dataset and how different pieces of data may be related to each other. Thus, a neural network is able to detect highly complex patterns in vast volumes of data. The arrangement of neurons in layers and the connections between and between layers is called neural network architecture. Neural network architectures can be classified into single-layer or multi-layer neural networks based on the layers present in the network. When determining the number of layers in a network, the input layer is not counted as a layer, because they are not counted. Therefore, the number of layers in a network can be defined as the number of interconnected link layers loaded into a slab of neurons.

1. Single Layer Neural Networks (SLNN):

A single-layer neural network represents the simplest type of neural network, consisting of only one layer of input nodes that rapidly send input to subsequent nodes or, in some cases, a single node. This single-layer design was part of the system infrastructure that has now become more complex. A single layer neural network consists of one layer of connection weights. That is, there is an input layer, an output layer, and a weighted connection link. The architecture of a single layer neural network is shown in the figure below. Input units (X1, X2,…Xn) receive signals from the outside world and send these signals to other neurons. Computed input units (Y1, Y2,…,Ym) receive input signals (X1, X2,…,Xn) through loaded communication links (W1, W2,....,Wn). The net input (yin) is the sum of the outputs of the input signals and the weights (Σx,y) and by applying activation functions produces the output (y) of the network. A single layer neural network can be used to solve the problem of pattern classification and pattern association. Although the training of a single layer neural network is simple, it cannot be used to solve more complex problems.

Figure 1.1 Single Neural Network

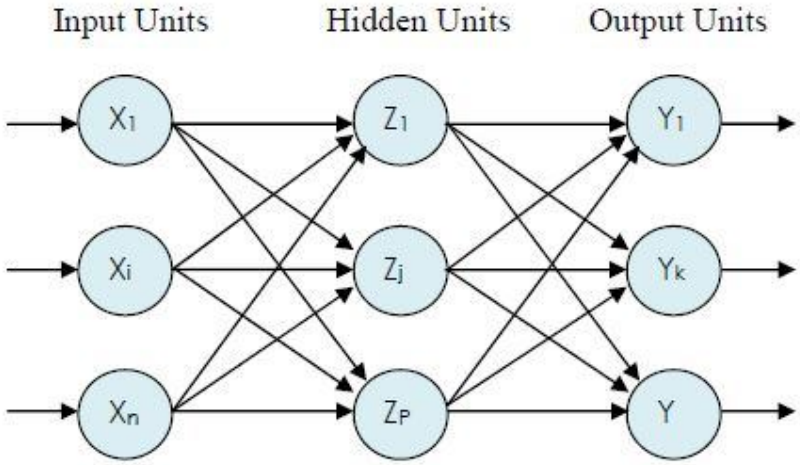


2. Multilayer Neural Network:

Multilayer neural networks are similar to single layer neural networks In addition to the input and output layers, they have one or more concealed layers. That is, one or more layers of the weight of the connection between the input and hidden layers and the hidden and output layers exist. The architecture of the multilayer neural network is shown in the figure below. Similar to single layer neural networks, input units (X_1, X_2,…,X_n) receive signals from the outside world and send these signals to the hidden layer. Hidden layers (Z_1, Z_2,…,Z_n) The sum of the output of the input signal and the weight is $(\Sigma x_i v_{ij})$ activation functions i.e. $f(z_{inj})$ creates the output of the network (zj) and sends this output to the output unit.

Output Units (Y1, Y2,….,Ym) Signals from units hidden by weighted connection links (W11, W12,...,WPM) (Z1, Z2,…Zn) Net output of input signals and weight output) If the response of the produced output neurons is not equal to the target value, the weight between the input and the hidden layers is modified by learning the weight between the hidden and output layers, and this process continues until the network produces the desired output. Multilayer neural networks can be used to solve more complex problems but the training process for multilayer neural networks is more difficult compared to single layer neural networks. In the present study, the backpropagation neural network model of multilayer neural networks is used.

Figure 1.2 Multilayer Neural Network



CONCLUSION:

A multilayer perceptron trained with a back-propagation algorithm is able to predict a patient's cardiac status from real-world data obtained from the UCI Machine Learning Repository. Different parameter values of the network affect the prediction accuracy. Specifically, the authors used principal component analysis to show that all 14 attributes of the dataset were important for the diagnosis of heart disease. We demonstrate that our system is able to achieve a high prediction accuracy of 92.2%, proving the utility of the proposed model in medical diagnosis.

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