Neural Networks and Fuzzy System

BSc Hons Computer Science

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Abstract:

There were many solutions and efforts made for this problem and many solutions are successfully implemented as well. This is another try to make a solution for breast cancer using neural network. I have used available data and trained my neural network and then test it on different cases to detect the breast cancer using different symptoms

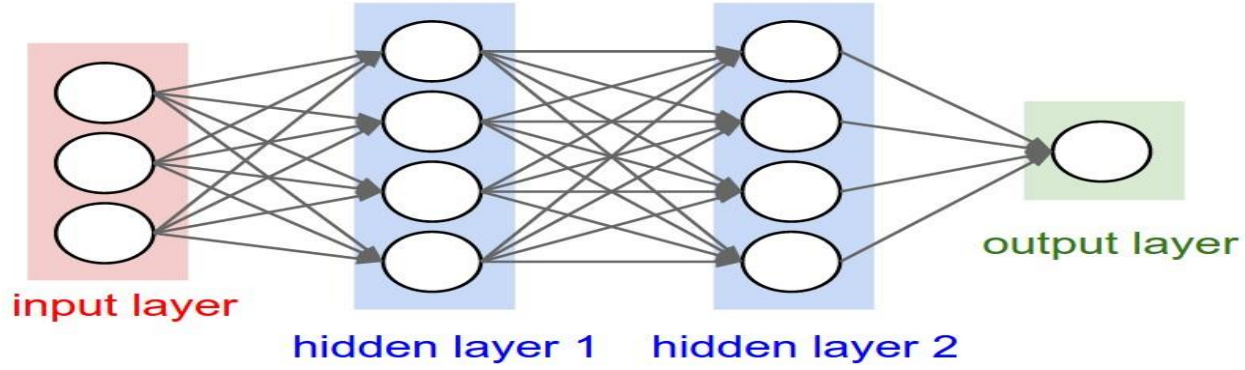
Introduction:

Breast cancer is the most dangerous disease in the world. It is an infectious tumor that occur in breast cells and that can rapidly grow in other cells of body. It is the most common disease in women and the second main cause of cancer death in women. It is also present in men and cause harm. Many efforts have been done to tackle such kind of disease. There are many techniques and methods have been used to diagnose this disease and have come up with good results. This report describes a problem where breast cancer data is available and there is a need to develop a neural network with the help of **"Feed Forward technique"** that whether a person has breast cancer or not. The breast cancer data is taken from UCI Machine Learning Dataset repository.

Background:

"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 (neurones) 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 neurones. This is true of ANNs as well." [3]

Neural Networks are practically and mathematically fascinating models for machine learning. They are inspired by basic units of nervous system of humans and animals. Each basic unit is known as **“Neuron”.** The first artificial neuron was produced in 1943 by the neurophysiologist **Warren McCulloch** and the logician **Walter Pits**. These neurons are connected to form a complex network. A neural network is consisting of many interconnected neurons. Neural Network has three layers named as an input layer, an output layer and a hidden layer in the middle (hidden means neither input nor output. The nodes are linked by connections which have a "weight" ("w" in the figure) that are analogous to synapses in the brain. Signal values propagate from the inputs, through the connection weights to the hidden nodes, and then onward through more connection weights to the output nodes.[2] There are a lot of applications for neural networks in security and medicine.



[1]

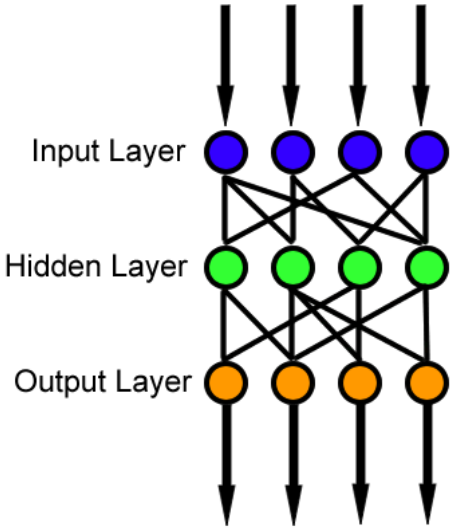
Hidden Layer:

The job of hidden layer is to convert the inputs into something valuable that the output layer can use. Earlier there were no hidden layers in neural network which really effects on the efficiency of neural network. Their output was, therefore, a relatively simple function of their input. Those two-layer, input-output "perceptrons" had crippling limitations.

There are two types of neural network.

Feed Forward Network:

Feed forward neural network contain directed acyclic graphs. In feed forward, signals travel only in one direction. They have fixed input and output. There are no loops in it. Feed forward neural network are commonly used to learn function to map an input to an output.



[5]

Feedback Network:

Feedback neural network contain cyclic graphs. In feedback, signals travel in both directions by introducing loops. “The feedback cycles can represent an internal state for the network that can cause the network's behavior to change over time based on its input”. [6]

Main Part:

This section contains description of method which we used to develop neural network. After implementing neural network, we gathered data and process data to obtain results. The dataset we used was taken from UCI Machine Learning dataset repository named as “Breast Cancer Wisconsin Data”. The data contains 699 rows and 11 columns. The first column was removed because it only contains IDs of patients which were not relevant for a neural network to be trained. There were 16 rows in column 6 where data is missing so we placed “0” instead of “?” in the dataset. The remaining 9 columns were symptoms of disease and the last column has only two values (2 and 4) where 2 indicates benign and 4 indicates malignant.

Hypothesis 1:

I sorted all the values in last column which is result column. Results are sorted in a way that all benign results which are represented by 2 are at top and all malignant results which are represented by 4 are at the bottom or comes after 2. When I pick data for training, I pick equal data from top and from

bottom so that my neural network could be trained on more diverse data. And in this way I will get much more accurate results in the end.

Result:

I came to know that this hypothesis doesn't works much better. It has a very little difference when I compare it with the picking scattered data.

Hypothesis 2:

By decreasing the validation checks while training and testing the neural network, the accuracy will be much better because the with the decrease in validation checks, the probability of accuracy will be more.

Number of hidden layers = 20

Validation checks = 6

Result:

Training Data	Testing	Accuracy
14%	86%	97%
29%	71%	96%
44%	56%	97%
59%	41%	95%
73%	27%	98%
88%	12%	99%

As it could be seen here that my I got mixed results. On some cases, the accuracy is increased and some cases it decreases. Although the results doesn't have much gap as compare to previous accuracy but in the end I would say that my hypothesis is wrong which leads me to make new hypothesis and test my assumptions through training and testing of neural network and also by making some change in the code.

Hypothesis 3:

I came to know that neurons in hidden layers learn all the things inside and process the given data and gives the output. So, if I would increase the number of neurons in hidden layers, this would also increase the accuracy as well. So, I changed the number of neurons in hidden layer from 20 to 30.

Number of neurons in hidden layer = 30

Validation checks = 6

Result:

Training Data	Testing	Accuracy
14%	86%	93%
29%	71%	96%
44%	56%	97%
59%	41%	97%
73%	27%	98%
88%	12%	99%

After getting above table of results I came to know that it doesn't improve the accuracy much and in most cases the results remain same as it was before. I might think that this happened because the

previous 20 neurons in hidden layer were enough to learn that much of data because of which increase in number of neurons in hidden layer doesn't affect much on the accuracy of neural network.

Hypothesis 4:

This time I came to see that the performance goal set as 0.01. The hypothesis which I made here is that while decreasing the performance goal which in other means reducing the error will eventually increase the efficiency of my neural network. So, I changed the performance goal from 0.01 to 0.001.

Number of hidden layers = 20

Validation checks = 6

Result:

Training Data	Testing	Accuracy
14%	86%	93.4%
29%	71%	94.4%
44%	56%	95.5%
59%	41%	99%
73%	27%	99%
88%	12%	99%

These above results show diverse results but overall the results are improved as compare to previous one. These results also show better accuracy when training data is more than 50 percent and testing data is less than training data. This is not an ideal case but very near to ideal case which is 100 percent accuracy.

Hypothesis 5:

I assume that by increasing training data gradually and decreasing testing data will increase the accuracy because with the increase in training data, the neural data will be more efficiently trained. Under are the results on my hypothesis.

Hidden layers on this hypothesis is 20.

Validation checks are 20.

Result:

Training Data	Testing	Accuracy
14%	86%	96%
29%	71%	97%
44%	56%	97%
59%	41%	97%
73%	27%	98%
88%	12%	100%

So, I came to know that my hypothesis is valid after getting more and more accuracy by increasing training data and decreasing testing data.

Conclusion:

After doing a lot of rigorous training and testing of neural network by changing different parameters e.g. hidden layers, ratio of training and testing data, epochs etc., I find out different results which truly made me aware of the effects of these parameters on the efficiency of neural network. I tried different changes in parameters and the goal was to achieve maximum efficiency so that to detect the disease of breast cancer more appropriately, and I would like to happily say here that my neural network achieved 100 percent accuracy.

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