

Examining the Performance of the Back Propagation Algorithm with the LabVIEW-based Classifier

Duygu Kaya¹, Mustafa Turk²

*Firat University, Department of Electrical and Electronics Engineering
Elazig/Turkey,*

Abstract: Artificial Neural Network (ANN) is inspired by the human brain and has a wide range of research and application possibilities for the modeling of brain behavior. In this context, the basic processing element of the central nervous system is the nerve cells and the main processing element of the ANN is the neurons. Neural networks have become an important means of engineering especially after improvements in computer technology. The main characteristic features of neural networks are that they are not algorithmic with adaptive and parallel scattered structure. ANN provides highly satisfactory results in areas such as signal processing, classification, particle recognition and functional imaging. At the same time, the ability to provide information about the class of the signal is of great interest to medical diagnostics. In this paper, breast cancer data used for ANN application were analyzed both in MATLAB and LabVIEW. Backpropagation algorithm is used as the algorithm. It has been observed that LabVIEW results are faster and more successful when the results obtained at LabVIEW are compared with MATLAB.

Keywords: ANN, Back Propagation Algorithm, Dimension Reduction, LabVIEW.

1. Introduction

The brain has the ability to find solutions based on past experiences gained in the face of any event based on cognition. ANN is inspired by the human brain [1]. The ability to find solutions through gained knowledge through neural perceptrons and the concept of ANN for modeling brain behavior have a wide range of research and application areas. The main processing element of ANN is neurons as in the nervous system. Artificial neurons form artificial neural networks by connecting them. ANN has the ability to remember, learn and generalize like the human brain. It can also learn and generalize through experimentation. Neural networks have become an important means of engineering especially after improvements in computer technology. The main characteristic features of neural networks are that they are not algorithmic with adaptive and parallel scattered structure [2]. ANN provides highly satisfactory results in areas such as signal processing, classification, particle recognition, and functional imaging [3]. At the same time, the ability to provide information about the class of the signal is of great interest to medical diagnostics [4-6]. The purpose of this work is to create a LabVIEW-based ANN classifier and to classify breast cancer data in the LabVIEW environment. The used breast cancer data in this publication is the Wisconsin Diagnostic Breast Cancer (WDBC) dataset from the University of California at Irvine [7]. It is also aimed to determine the correctness of the classifier by comparing the results of the classification with the results obtained in the MATLAB environment. Thus, it is thought that the classifier created in LabVIEW can be used to classify different data.

2. Artificial Neural Network

Artificial neural network (ANN) is one of the main tools used in machine learning. Neural networks consist of input, output layers and hidden layer. The layer from which the inputs surrounding the ANN are introduced is the input layer. The hidden layer is the layer where the information coming from the input layer is processed and sent to the output layer. There are no hidden layers in some ANN, and some can be selected more than others depending on the ANN model used. The number of hidden layers and the number of neurons in these layers need to be chosen in such a way that the network can work best. With the appropriate number of hidden layers and neurons in these layers, the ANN will be effective in solving complex problems, despite increasing computational complexity and time. If too many hidden layers are selected as necessary, excessive parameter will cause excess, resulting in insufficient generalization due to untrained data. Thus, the most popular method of finding the number of hidden layers is trial and error [8]. The output layer processes the information coming from the hidden layers and sends the output of the network to the outside environment. In the feedback networks, new weight values of the network are calculated by using the output produced in this layer. The ability of ANN to model nonlinearities is the most important feature of having a parallel structure, the ability to learn and generalize, adaptability, and fault tolerance [9,10]. ANN has been successfully used to classify nonlinear, irregular and noisy data.

3. Dimension Reduction Algorithms

Dimension reduction is used to extract feature for a good analysis of a raw data. Using it, more robust learning models can be created because of the elimination of insignificant features of the data. Feature extraction is the process of creating a new feature set from the set that contains all the important features. Dimension reduction is useful to avoid excessive mismatch by minimizing the error in the parameter estimation as well as reducing the account load. In this paper, Principal Component Analysis (PCA) is used for dimension reduction. PCA is used to eliminate dependency structure and to reduce dimension. PCA aims to direct data to the side with the highest variability [11]. This approach tries to find the strongest pattern in the data.

4. LabVIEW

LabVIEW is a graphical programming language that uses a data flow model instead of a sequential script. Compared to other languages, LabVIEW allows multiple operations to be performed in parallel, since it can work with a data stream instead of sequential code sequences [12]. With LabVIEW, it allows programs to be processed faster and prevents time lost. Because it resembles the physical instruments used in the lab, LabVIEW is also known as Virtual Instrument (VI). It has the ability to do any kind of operation that other programming languages can do. LabVIEW enables drag-and-drop interface creation and visualization of results with data visualizers. Figure 1 shows the front panel and block diagram of LabVIEW. While the front panel corresponds to the part of the user interface, the block diagram corresponds to the part where the graphical codes are prepared. LabVIEW has several toolkits for different purposes. In this paper, biomedical toolkit, machine learning toolkit and advanced signal processing toolkit are used.

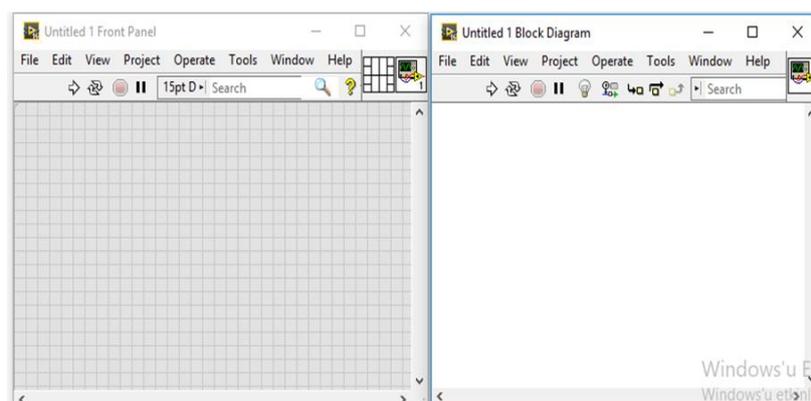


Figure 1 :The front panel and block diagram of LabVIEW

5. Application Results

For ANN application, the used breast cancer data is taken from [7]. Application is done both in MATLAB and in LabVIEW for comparing the different programming language. The created program in LabVIEW is shown in Figure 2. Firstly, the data dimension is reduced from 9x699 to 4x699 with PCA, in other words significant features are chosen. Then, data is divided into training and test data by 80% and 20%, respectively. Training data were sent to the Back propagation (BP) learning block. The network consists of 4 features at input layer, 2 output and 5 neuron at hidden layer. BP algorithm is used as the algorithm. The mean square error (MSE) is selected as 10^{-5} . Network features are listed in Table 1. Comparison of LabVIEW and MATLAB performance is listed in Table 2 and LabVIEW performance results, such as precision, sensitivity, specificity, Rand Index, recall and F measure are listed in Table 3. The histogram of the results is shown in Figure 3.

Table 1: Network Features

Input	Hidden Neuron	Min MSE	Max iteration
4	5	10^{-5}	1000

Table 2: Comparison of LabVIEW and MATLAB performance

Programming Language	Classification Accuracy	Time
LabVIEW	%99.2857	1.567s
MATLAB	%95.7	8.992407s

Table 3: LabVIEW Performance Results

Precision	Sensitivity	Specificity	Rand Index	Recall	F measure
0.98412	1	0.98412	0.985714	1	0.99199

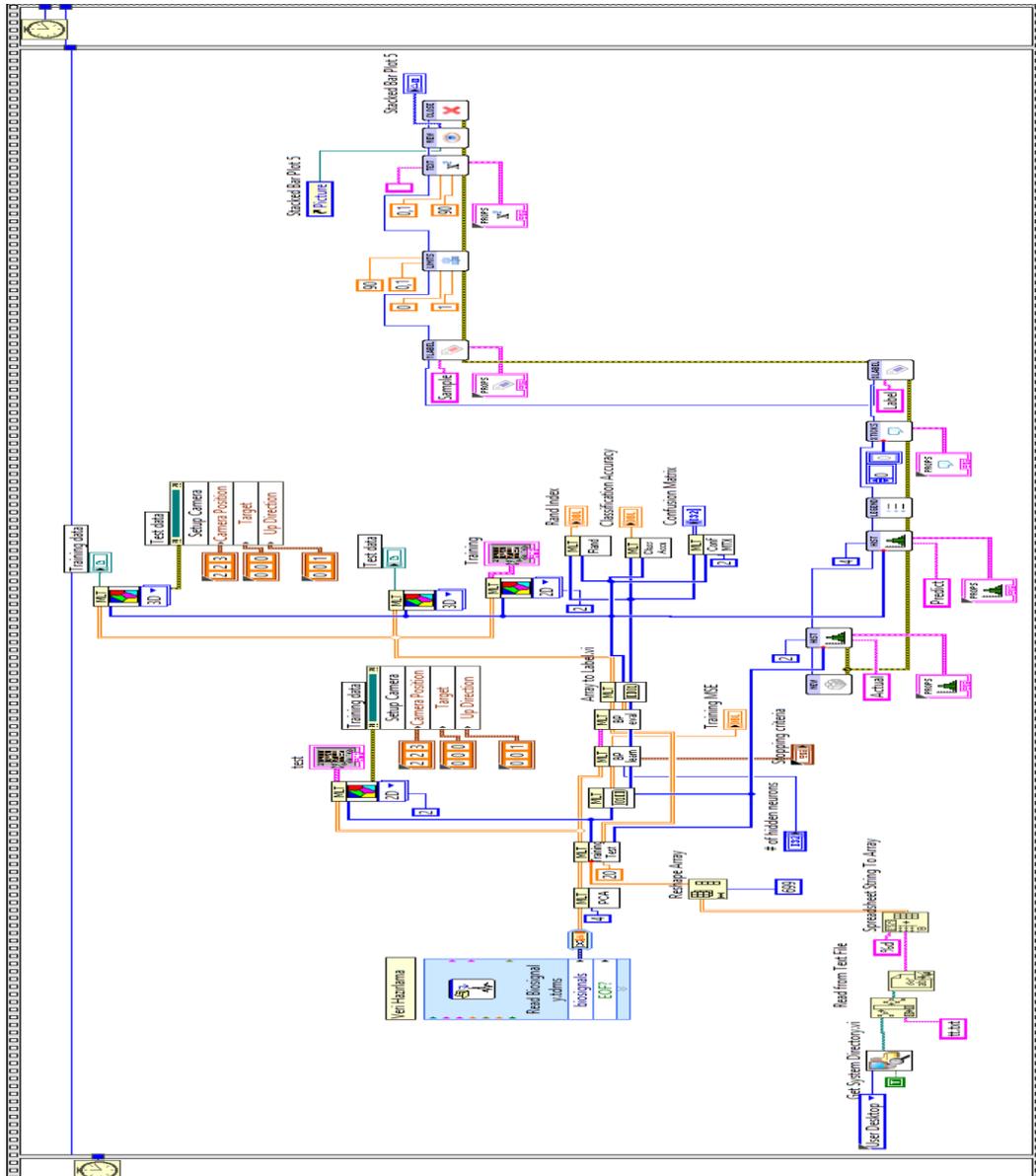


Figure 2: The created BP programme in LabVIEW

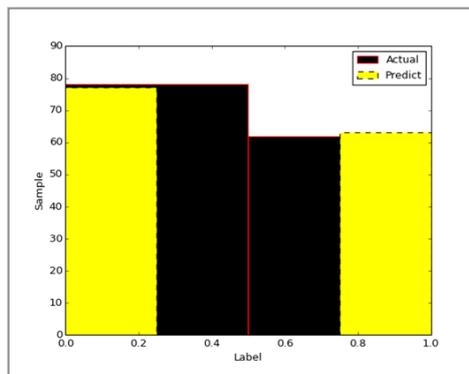


Figure 3: Histogram Results

The obtained results showed that classification results obtained using the back-propagation algorithm in the LabVIEW environment are faster and more successful than the results obtained in the MATLAB environment. LabVIEW performance parameters are close to 1, indicating that the program is working very well.

6. Conclusions

LabVIEW is a graphical programming language that uses a data flow model instead of a sequential script. Compared to other languages, LabVIEW allows multiple operations to be performed in parallel, since it can work with a data stream instead of sequential code sequences. With LabVIEW, it allows programs to be processed faster and prevents time lost. So, in this paper showed that classification results obtained using the back-propagation algorithm in the LabVIEW environment are shown to be faster and more successful than the results obtained in the MATLAB environment. So, other classification types can also be implemented in the LabVIEW environment because of the good success rate.

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Author Profile



DUYGU KAYA was born in Gaziantep, Turkey 1986. She received the B.S. degree in Electrical-Electronics Engineering from the Inonu University in Malatya 2010, M.S. degree from the Firat University in Elazig 2013 and PhD degree from the Firat University in Elazig 2018. Since 2010, She is a Research Assistant at the Department of Electrical-Electronics Engineering, Faculty of Engineering, Firat University in Elazig, Turkey.