GUI FOR CLASSIFICATION USING MULTILAYER PERCEPTRON NETWORK

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Abstract

The paper deals with the classification of points to class using Multilayer perceptron (MLP) network. For this purpose, there was created program in Matlab with graphic user interface (GUI), which was assigned in testing MLP networks for classification problems of linear non-separated groups of points in 2D and 3D space. For classification, there was used MLP network with one or two hidden layers. Logical sigmoid function was used in the all layers of network.

1   Principle of classification using MLP networks

A single layer perceptron networks can be used only for classification of linearly separable problems. For classification problems of linear non-separated groups of points, there was used MLP network with one or two hidden layers [1, 2]. The aim of the MLP network is to classify inputs, or in other words externally applied stimuli x_1, x_2, …, x_n, into appropriate class from classes A_1, …, A_m. Linearly separable and linearly non-separable groups of points for two inputs are displayed in figure 1.
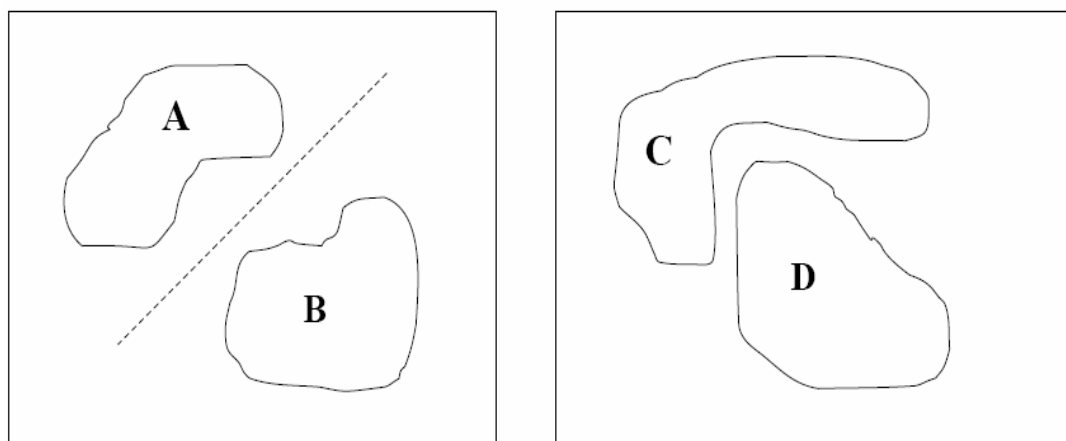

Figure 1: The linearly separable (A, B) and linearly non-separable (C, D) groups of points

The structure of MLP network is displayed in Figure 2. In the all layers of network, there was used logical sigmoid function (logsig) in the following form:

$$\varphi(a) = \frac{1}{1 + e^{-\beta a}}$$

The network inputs are represented by parameters in range (0, 1), on the basis which is realized classification to classes. In our case, the network inputs are x, y, z axis coordinates of points. The number of network outputs is defined according to classified groups. Every network output has the value in the range (0, 1) and represents point classification rate for individual groups. For MLP network training, there was used the modified algorithm of back-propagation errors with adaptive learn rate and momentum parameter [5].
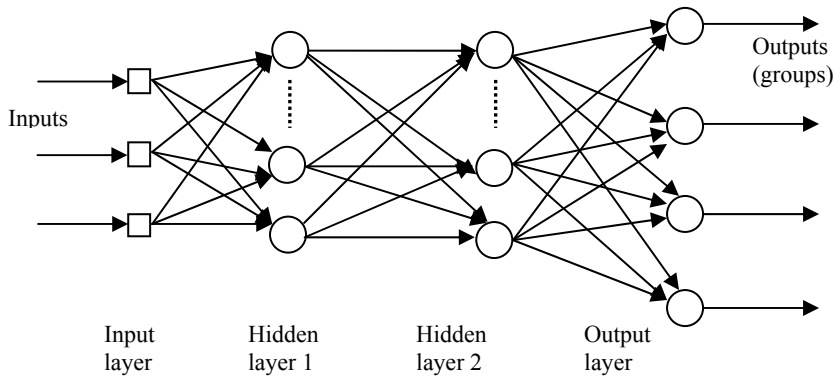
Figure 2: The structure of multilayer perceptron network

2   GUI of demo program for classification using MLP network

In Figure 3, there is described window of program for classification using MLP network, in which is possible to put data for classification, set network parameters, realize training and testing of network [3]. Before begin of solving the classification problem, there is necessary to put number of network inputs and number of classification groups. The groups of points setting is possible using mouse, keyboard and randomly in 2D or 3D space. After the groups of points setting and setting of training network parameters, the network training can be started. Testing of classification using MLP network is possible by click to the buttons Test1, Test2 and Test3. In test no. 1, MLP network classify putted points using mouse, keyboard or randomly. In test no. 2 and 3, MLP network classify points in the all space. Graphical interpretation of classification in the test no. 2 is using the grid with colored symbols. Graphical interpretation of classification in test no. 3 is using the colored areas and colored tone represents the classification rate for specific group (see figures 6, 9, 12).
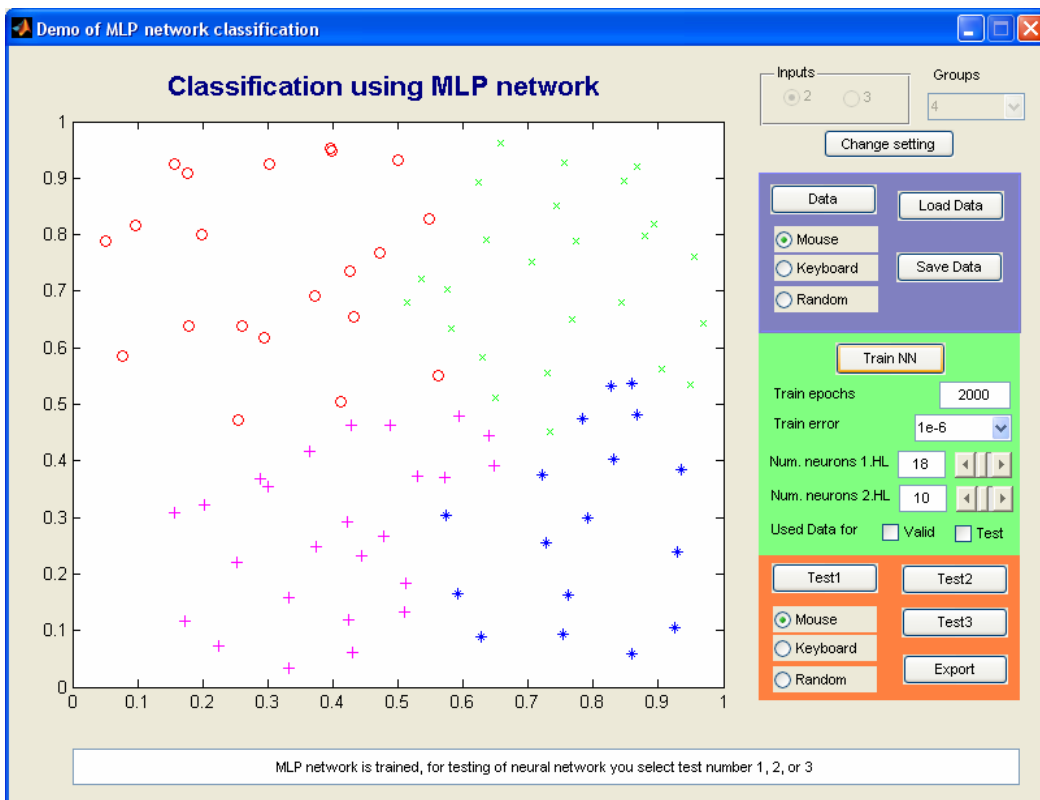

Figure 3: The GUI of demo program for classification using MLP network

3 Example of classification in 2D space

In figure 5, there are displayed points of four groups in 2D space for classification using MLP network. For classification, MLP network with one hidden layer with 15 neurons was used. Process training of MLP network is displayed in figure 4. Classification results using MLP network are depictured in figure 6.
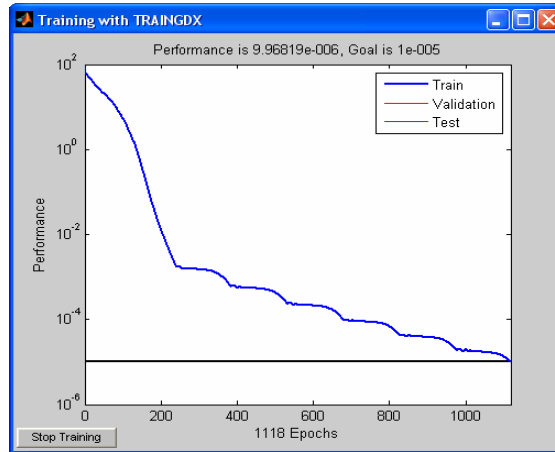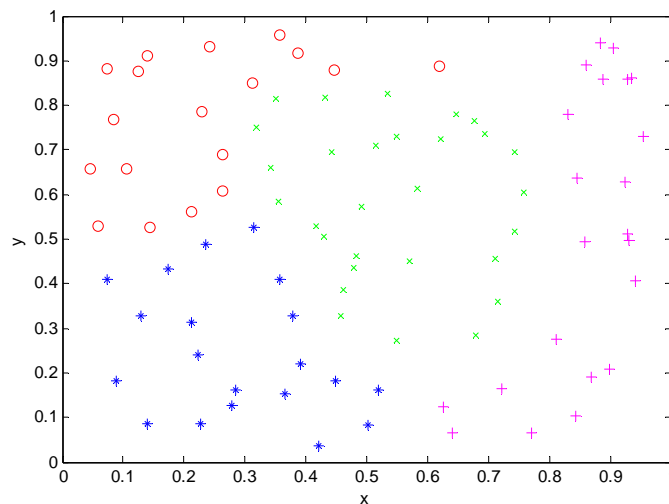

Figure 4: Training process of MLP network

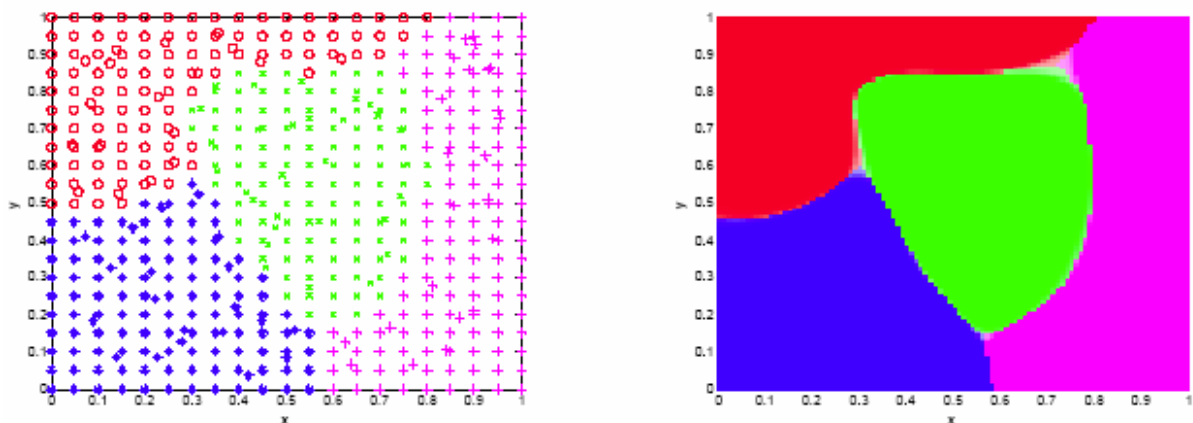Figure 5: Defined points of four groups for classification using MLP network

Figure 6: Testing of classification using MLP network in 2D space

In figure 8, there are displayed points of five groups in 2D space for classification using MLP network. For classification, the MLP network with two hidden layers with 25 and 17 neurons was used. Process training of MLP network is displayed in figure 7. Classification results using MLP network are depictured in figure 9.
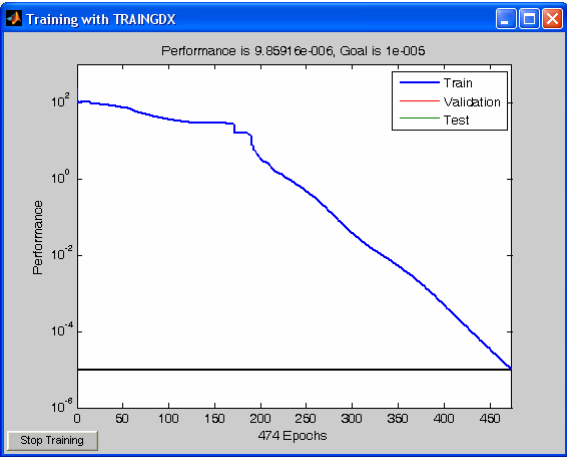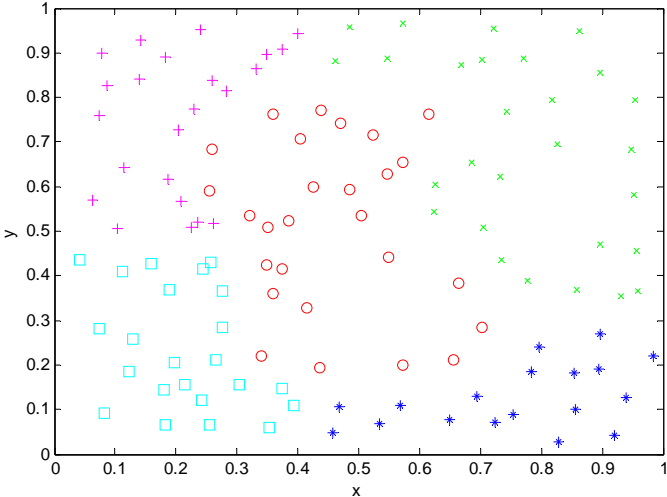

Figure 7: Training process of MLP network

Figure 8: Defined points of five groups for classification using MLP network
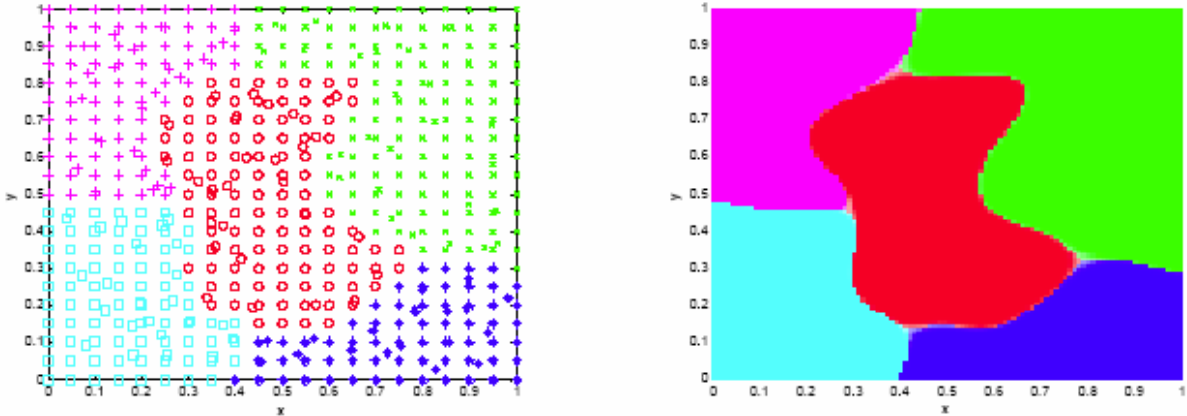

Figure 9: Testing of classification using MLP network in 2D space

4   Example of classification in 3D space

In figure 11, there are displayed points of four groups in 3D space for classification using MLP network. For classification, the MLP network with one hidden layer with 12 neurons was used. Process training of MLP network is displayed in figure 10. Classification results using MLP network are depictured in figure 12.
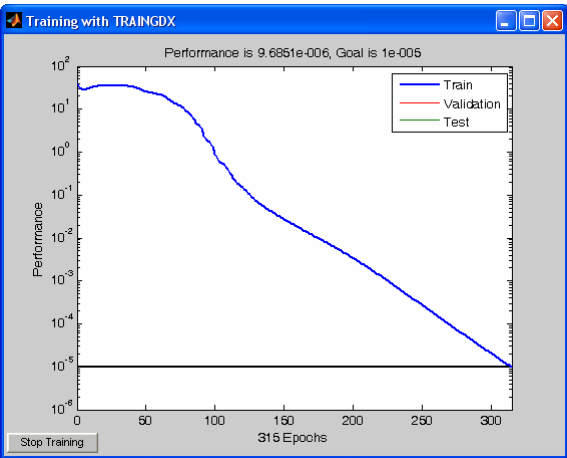

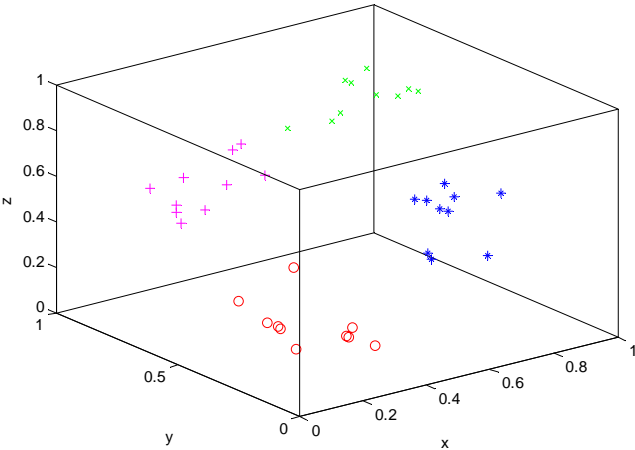Figure 10: Training process of MLP network

Figure 11: Defined points of four groups for classification using MLP network
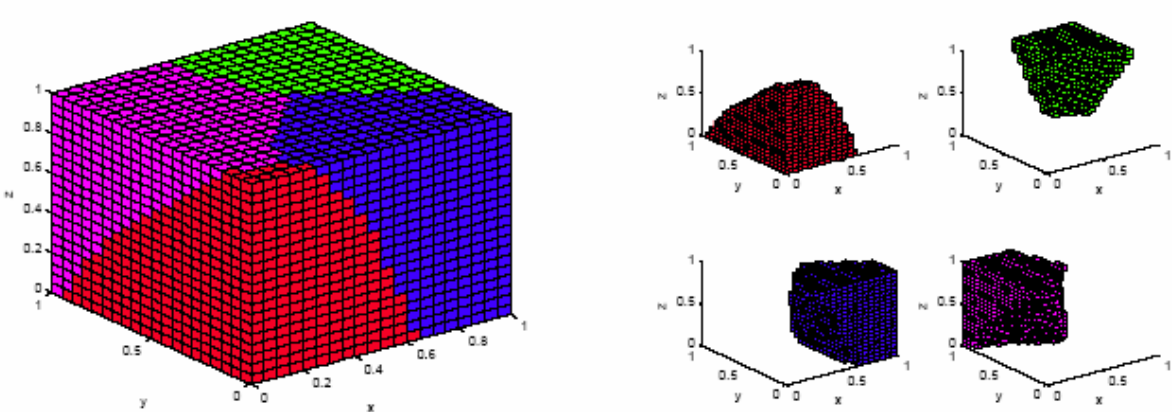

Figure 12: Testing of classifcation using MLP network in 3D space

5 Conclusion

The main objective of this article was to demonstrate very good properties of MLP network for classification problems. The created program for classification using MLP network with GUI is possible to use for testing several classification problems. Due to good approximate properties, the MLP network can classify linearly non-separable problems very good. The demo program enables graphical representation of classification results in Matlab.

Acknowledgement

References

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