Developing a Software that Train Neural Networks by Artificial Bee Colony Algorithm (ABC)

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Abstract

Artificial neural network is known to have disadvantages such as over-fit and get stuck in local minima. This problem can be solved by specific optimization algorithms. In this study, the software was developed and a successful algorithm in global minima which is artificial bee colony (ABC) is used to train artificial neural networks. By help of windows forms in this software, users can design an artificial neural network in a few steps and can train simply this designed network by providing specific parameters. The test results of designed neural network and comparisons of performance are graphically displayed to the users. Because of the software can accept a wide variety of data the software can be used in many areas.

Key words: artificial bee colony algorithm, artificial neural network, training, C# programming

1. Introduction

Various optimization algorithms can be used to get better results in data classification. In this study, data, especially electronic nose data, was classified by using neural network and for getting better results the network was optimized and trained by Artificial Bee Colony (ABC) algorithm. Software was developed by using Microsoft Visual C# programming language and this developed program provides users to enter their data by only a few steps. They can easily design their neural network by this program and can enters parameters to do train and test procedures.

Considering the studies in the literature, training of neural networks was tried to improve by various optimization algorithms [1]–[5]. For example training of artificial neural network was optimized by using Bird mating optimizer algorithm [1]. In another study, a neural network was optimized by ant colony optimization to predict bottom hole pressure in underbalanced drilling. The performance coefficient of ACA-BP was 0.992 but back propagation (BP) was 0.852. [6]. In the study of Uzlu et al. they have tried to predict hydroelectric production for year 2021 in Turkey. They compared classic ANN with ABC-ANN and they obtain better results from ABC-ANN[2]. In a study which is in the medical field about cancer diagnosis, artificial neural network with genetic algorithm was used and especially in the non-linear part of the study they obtain better results than BP-ANN [3].

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ABC algorithm firstly was developed by Karaboga and then used by many studies and they get good results [7]. Especially in study done by Karaboga [8] training phase of Artificial neural network was optimized by ABC and was obtained 100 % performance.

Software was developed in light of these studies. The software allows users can design their neural network, it perform train stage separately by classic back propagation and artificial bee colony algorithm then test these networks and analyze performance by test data which haven't been seen before by network.

This study was organized; in section two the developed software was described in detail, in conclusion part results were examined.

2. The Developed Software

Microsoft Visual C# programming language was used to developed windows application to classify data by using neural networks that trained by back propagation method and ABC algorithm separately. When a user enters data to the program and design neural network by help of the program, the training was done by BP and ABC separately then results showed in graphical interface to the user. Performance graphs were supported by visual windows. The class diagram of software developed showed in Figure 1.

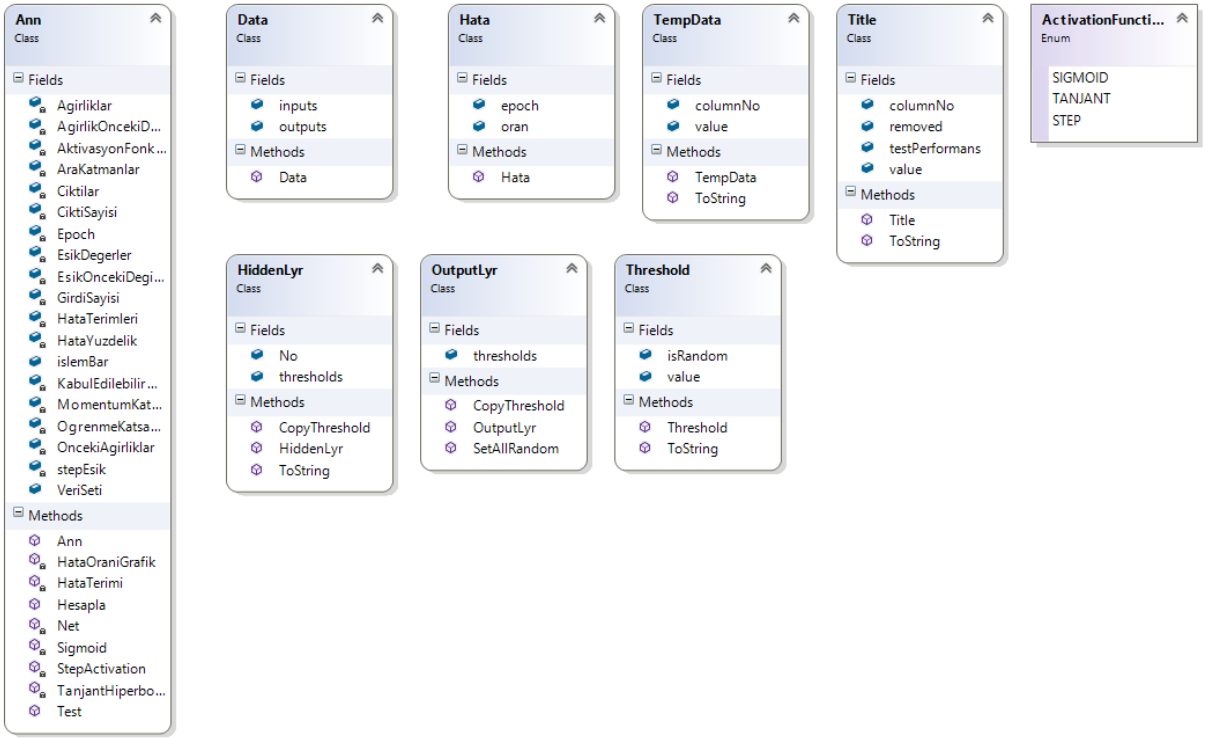

Figure 1. Class diagram of the program

A big window opens when the program starts. The Windows is shown in Fig. 2. As seen from Fig. 2. to create a new Project user should press new icon.

Figure 2. Main window of the program

When the new icon is pressed, a window opens for choosing dataset and the Window is shown in Fig. 3. This window provide a dataset can be read to the program in excel and txt format. In the same window dataset, train and test ratios can be set. If the dataset has title row, user should specify it in this window. When all things in this window are set then user can click the next button to arrange attributes of dataset.

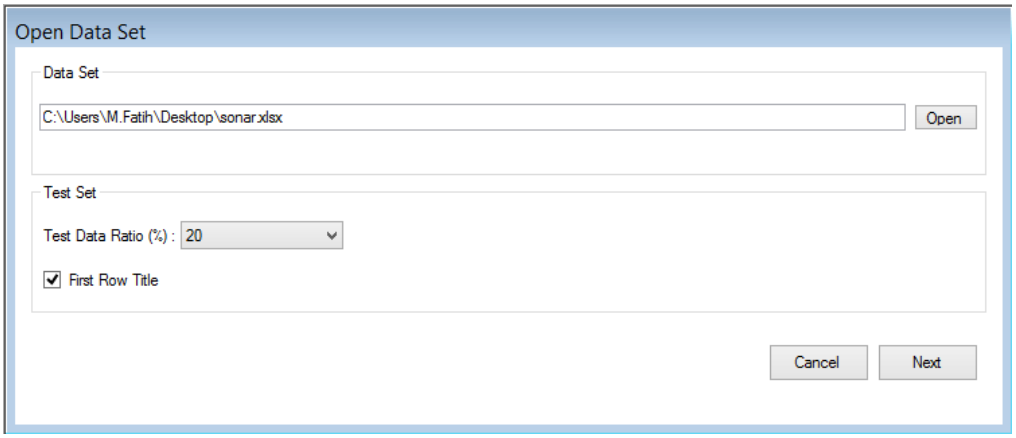

Figure 3. Dataset selection window

In Fig. 4 user can remove some attributes from dataset because of user doesn't want to include these attributes in training process. To accomplish this user should choose attribute from combo box then should press the remove button. From the same window user can determine which attribute is the output (Fig. 4).

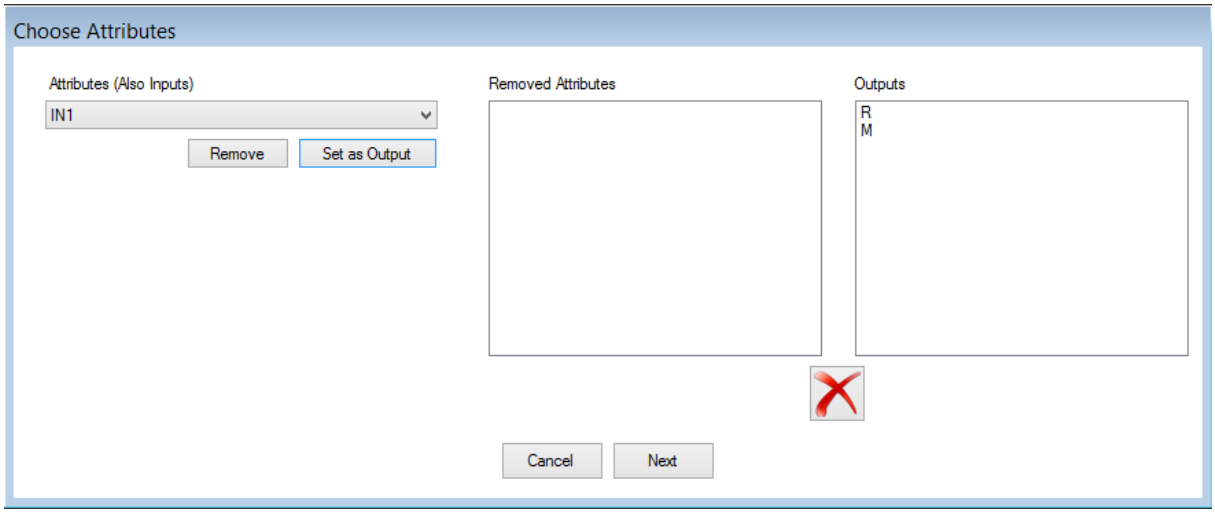

Figure 4. Edit attributes window

After completing process of choosing attributes the next button is clicked then detailed settings of artificial neural network and the ABC algorithm can be orginized window comes to the screen. This screen can be seen in Fig. 5. User can draw which neural network he/she want. The user can set up hidden layers in various ways and also he can determine how many neurons a layer has in it. The threshoulds of neurons

After setting up attributes user should press next button to reach set up window that setting Artificial neural network and ABC in details. The window can be seen on Fig. 5. In this window, the artificial neural network that will be trained can all details be setup. Also user can set up how many hidden layers the artificial neural network should have and how many neurons should have in one layer. User can assign a value to thresholds of neurons or he can be allow program to assign them randomly. Weights in the network can be given values between some specific values. The details of training by ABC are also set up in this window. In order to run, ABC needs five parameters apart from BP. Program allows users to choose Sigmoid, Hyperbolic Tangent or step as activation function. At the below code block it can be seen how these activation functions work.

```
private double Sigmoid(double net){
        double cikti = (1 / (1 + Math.Pow(Math.E, -net)));
        return cikti;
}
private double TanjantHiperbolik(double net){
        double cikti = ( Math.Pow(Math.E, net) + Math.Pow(Math.E, -net) ) / (
        Math.Pow(Math.E, net) - Math.Pow(Math.E, -net) );
        return cikti;
}
private double StepActivation(double net){
        double cikti;
        if(net > stepEsik) cikti=1;
        else cikti = 0;

        return cikti;
}
```

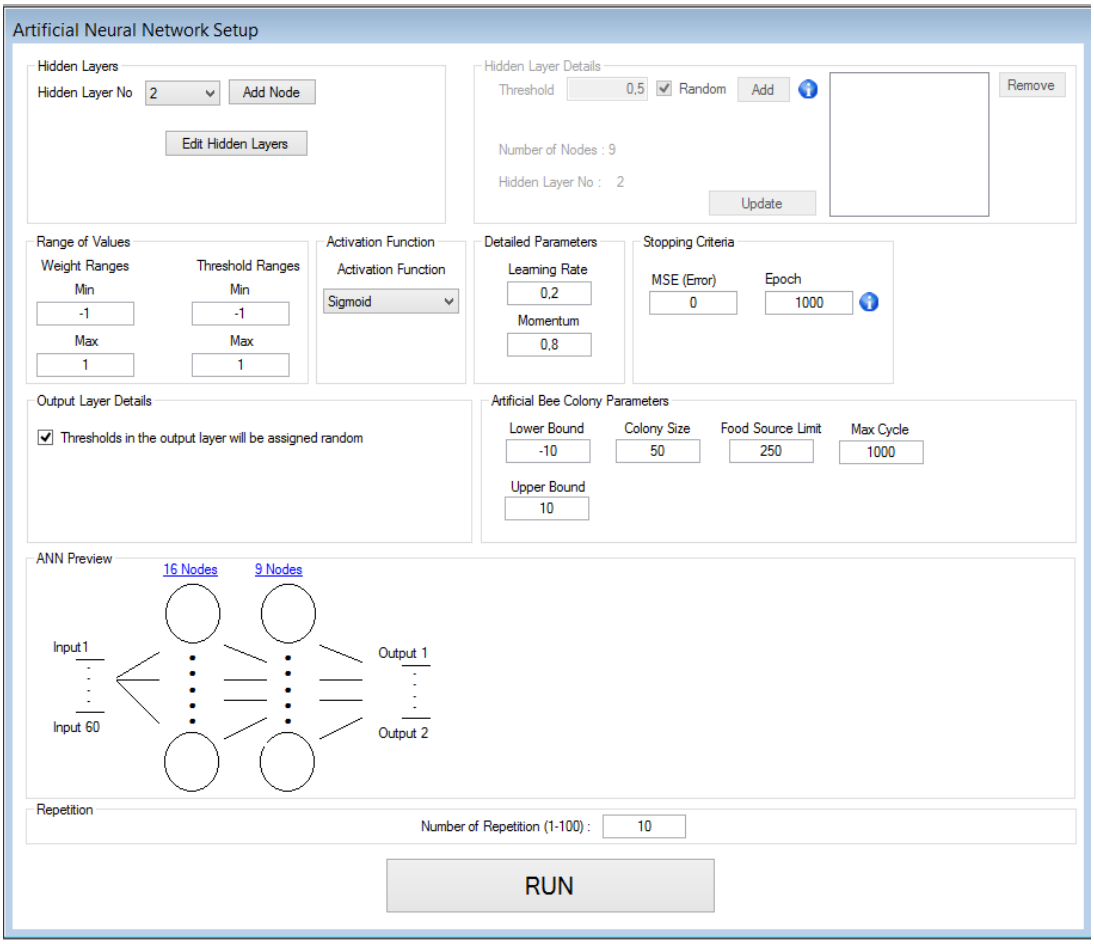

Figure 5. Program setup window

As can be seen from Fig. 5 learning of ANN and momentum rates can be determined by this window. Two important stopping criteria can be mentioned in Artificial neural network [9]. These are specific mse value or epoch limit. These two stopping criteria was considered in the software and if user want he can stop the training process by mse value or some specific epoch number.

We developed a preview window in the software to show users what neural network they design. Users can determine from this window how many times the training process will repeat. The repeat process run such as it shows the same training dataset to the neural network again and again. And every time it tests the trained neural network by giving test dataset to it. At the result average values will showed to the user.

Conclusions

In this study, training process of artificial neural network was done by artificial bee colony optimization algorithm. By aid of this study user can simply compare ANN-BP with ANN-ABC and see the results. The software designed to accept every kind of dataset and software gives the opportunity to the user in designing his network structure from the beginning. Showed results are

supported by graphical interfaces. In these graphical interfaces users can see mse and test performance graphs separately.

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