Flower Pollination Neural Network For Heart Disease Classification

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Abstract. Heart Disease are among the leading cause of death worldwide. The application of artificial neural network as decision support tool for heart disease detection have been previously proposed. However, artificial neural network using conventional back propagation algorithm for error minimization and these algorithm tend to stuck at local minima. This paper proposed the use of flower pollination algorithm as a substitute to conventional back propagation algorithm for error minimization. Heart disease dataset obtain from UCI machine learning repository is used to evaluate the performance of the proposed framework. The results show that the proposed flower pollination neural network able to produce higher classification accuracy compared to the conventional back propagation neural network algorithm.

1. Introduction
Heart disease describes a range of conditions that affect your heart in which are the leading cause of death worldwide where more people die from cardiovascular diseases compared to any other causes annually. The early detection of heart disease can help the patient to adjust lifestyle and also help the medical professionals to prescribe appropriate medicine. However, the diagnosing patient with the presence of heart disease can be challenging where it depends on medical professional’s experience and intuition [1,2]. It is imperative for medical professionals to have a system that can help them predict and classify the patient who have high risk of getting heart disease.

The implementation of machine learning algorithm can help medical professionals in diagnosing the presence of heart disease in the patient. Machine
learning algorithm have become very popular for solving classification problems where it is capable of mapping the relationship between variables or attributes with minimal human effort. Artificial Neural Network (ANN) are among the most popular machine learning algorithm where it proves to be powerful tools for mapping nonlinear data and are known to be useful in solving nonlinear problems where the rules to solve the problem is difficult to obtain or unknown [9,10]. However, artificial neural network using conventional back propagation algorithm for error minimization and these algorithm tend to stuck at local minima [6]. Among the the approach to avoid local minima is to train neural multiple times but it consumes a lot of computational power [6]. This paper proposed the use of flower pollination algorithm which has been used to solve optimization problem for error minimization in neural network. Statlog heart disease dataset, Cleveland heart disease dataset, Hungarian heart disease dataset and Switzerland heart disease dataset obtain from University of California, Irvine machine learning data repository are used to measure the performance of proposed flower pollination neural network [8].

2. Methodology

2.1 Flower Pollination Algorithm

Flower pollination algorithm has been proposed in 2013 by Xin-She Yang which inspired by characteristic of biological flower pollination in flowering plant. Essentially, flower pollination algorithm can be explained using following rules [4]:

1. Cross pollination and biotic is considered as global pollination process where pollinators that carrying pollen performing random walk known as Levy Flight.
2. Local pollination is done by agent called abiotic
3. Flower constancy can be considered as the reproduction probability is proportional to the similarity of two flowers involved.
4. Switch probability $p \in [0,1]$ controlled local and global pollination. Local pollination can have significant fraction $p$ in overall pollination activities because of physical proximity and factors such as local pollination and wind.

2.2 Flower Pollination Neural Network

In the proposed flower pollination neural network algorithm, each best pollen represents a possible solution (the initial weight space and corresponding biases for neural network optimization). The weight optimization problem and population size represent the quality of the solution. In the first epoch, the best initial weights and biases are initialized with Flower Pollination. Subsequently, those weights are passed on to the neural network. The weights in neural network are computed and compared with the best solution. In the second cycle, the flower pollination updates the weights with the best possible solution. The flower pollination continues searching the best weights until the last cycle/epoch of the neural network is
reached or the target minimum error is reached. Figure 1 shows the simplified flow of flower pollination neural network algorithm.

Figure 1 Flower Pollination Neural Network Flowchart

2.3 Experimental Setup
The proposed flower pollination neural network uses four sets of heart disease data obtain from machine learning repository of University of California, Irvine [8]. The Statlog dataset, Cleveland heart dataset, Hungarian heart dataset and Switzerland heart dataset is used to evaluate the performance of proposed framework. The result of simulation then compared to the performance of parameter tuned neural network that use conventional back propagation algorithm which has been proposed previously [3]. The previously proposed parameter tuned neural network using multi training approach to overcome local minima. Dataset is partition into
ratio of 70% for training, 15% for validation and 15% for testing. The proposed flower pollination neural network and parameter tuned neural network are simulated using MATLAB R2014b with the specifications of Intel core i-7, RAM of 12 GB and operating on Windows 10 64 bit.

3. Results and Discussion
Table 1 shows the comparison of classification result between standard neural network compared to the proposed flower pollination neural network.

| Dataset          | Algorithm                  | Training Dataset | Validation Dataset | Test Dataset | Overall Accuracy |
|------------------|----------------------------|------------------|--------------------|--------------|------------------|
| Cleveland Heart Dataset | Neural Network             | 91.4             | 86.7               | 71.7         | 86.2             |
|                   | Flower Pollination Neural Network | 93.2             | 86.7               | 88.3         | 90.9             |
| Hungarian Heart Dataset | Neural Network             | 83.5             | 84.6               | 80           | 83.1             |
|                   | Flower Pollination Neural Network | 89               | 84.6               | 87.5         | 88.1             |
| Switzerland Heart Dataset | Neural Network             | 92               | 93.3               | 80           | 90.5             |
|                   | Flower Pollination Neural Network | 97.3             | 93.3               | 100          | 97.1             |
| Statlog Dataset  | Neural Network             | 87.5             | 81.5               | 85.2         | 86.7             |
|                   | Flower Pollination Neural Network | 89.4             | 92.6               | 88.9         | 89.6             |

Flower pollination neural network able to produce higher accuracy compared to the previously proposed parameter tuned neural network using multi training approach. The result shows that the proposed flower pollination neural network able to achieve high classification accuracy with the overall accuracy of 90.9% for Cleveland dataset compared to 86.2% classification accuracy for neural network with multi training, 88.1% for Hungarian dataset compared to 83.1% classification accuracy for neural network with multi training, 97.1% for Switzerland dataset compared to 90.5% classification accuracy for neural network with multi training.
and 89.6% of classification accuracy for Statlog dataset compared to 86.7% classification accuracy for neural network with multi training.

4 Conclusions
The flower pollination neural network for heart disease classification is proposed in this paper. The proposed flower pollination neural network classification accuracy is higher compared to the standard backpropagation neural network with multi training approach.

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