Implementation artificial neural network nguyen widrow algorithm for lupus prediction

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Abstract. Lupus is a type of skin disease known as 1000 face disease. This term arises due to this chronic disease causing symptoms and signs that are almost similar to other diseases. Artificial neural network is one method that can be used to help the medical world in managing clinical data. Nguyen Widrow is one of the algorithms and artificial neural network that can be used to make predictions and improve the iteration process. This study applying Nguyen Widrow algorithm in predicting lupus by Matlab. Based on the results of the training process, the Nguyen Widrow initialization algorithm is able to recognize patterns of 80% or range 16 of the 20 datasets. As for the results of testing Nguyen Widrow initialization algorithm with the initials activation function hidden = logsig, activating output logsig, target error 0.1 and learning rate 0.1, Epoch 10000 able to recognize 100% of patterns from 10 existing datasets. So from that it can be concluded that the Nguyen Widrow initialization algorithm can be used to predict disease patterns.

1. Introduction
Skin disease is a disease that is common in all ages, the skin is a part of the human body that is sensitive to various diseases [1]. Skin diseases can be caused by several factors, namely life habits and the environment. Skin diseases can develop in personal hygiene and poor environmental hygiene [2]. Lupus is a type of skin disease known as disease of 1000 faces, this term arises from chronic diseases that cause symptoms and signs that are almost similar to other diseases. This disease tends to be difficult to detect early. This disease occurs because of an attack on healthy cells in the body, and usually the attacker is an immune system in the human body itself [3]. Autoimmune is a term usually mentioned in the process of attacking autoantigen [4]. Lupus sufferers are often referred to as odapus, the life of odapus can change dramatically since lupus and they find it very difficult to manage this disease [5].

In helping doctors deal with the problem of lupus, several researchers proposed the concept of artificial intelligence, one of which is the neural network. Neural network has an accurate way of working in analyzing, understanding and modeling clinical data. Such as diagnosing hepatitis [6], chest disease [7], diabetes [8], heart [9]. Artificial neural network has accuracy in predicting nonlinear things and the ability to tolerate errors that exist in the work process [10]. As one of the sciences that applies sophisticated computerized science, each existing method can be used to deal with changing problems that the system might not have anticipated in the development process. When most computational methods and statistics fail in the process of data pattern recognition, on the contrary artificial neural networks can show their ability in pattern recognition [11]. One of the most widely used neural network is Backpropagation which
has a continuous learning process and makes corrections in a backward sequence. This model is widely used both for the process of recognition and forecasting with more optimal accuracy results [12].

Nguyen Widrow is one method that can be applied with other methods, one of which is Backpropagation. In addition to predicting Nguyen Widrow, it is also used to improve the initialization process so as to accelerate the process of achieving convergence. Several previous studies have suggested several algorithms to improve accuracy such as ant colony optimization [13], bee colony algorithm [14], genetic algorithms [15]. In this study using the Nguyen Widrow algorithm for predictions of lupus skin disease. This research is presented with part 2 which is the methodology, part 3 results and discussion, part 4 is the conclusion.

2. Methodology
Artificial neural networks basically apply the concept of how natural intelligence works in the human brain. Each artificial neuron has a relationship with one another in order to create an artificial neural network [16]. Artificial neural networks try as much as possible to get exponential values in architectures that have multiple layers of input and output processes [17].

Artificial intelligence has a variety of algorithms that can initialize the value of weight, one of which is the algorithm for widrow, so that it can influence the process of training time. In the concept using a scale factor \(0.7 (p)^{1/n} = 0.7 \frac{1}{n} \sqrt{n} p\).

In this study the data obtained consisted the symptoms of lupus that are commonly experienced by patients and some sample data of patients who have performed examinations with diagnoses of lupus or that resemble the symptoms of the disease. In this study using 8 symptom data, each of which is given code information \(x1\) to \(x8\). Symptom data can be seen in Table 1 and for sample data there are 30 data in Table 2.

### Table 1. Symptom data

| Code | Symptom          |
|------|-----------------|
| x1   | Joint pain      |
| x2   | Wounds on mouth and nose |
| x3   | Proteinura      |
| x4   | Skin rashes     |
| x5   | Hair loss       |
| x6   | Fever           |
| x7   | Out of breath   |
| x8   | Convulsions     |

### Table 2. Sample data

| No. | x1 | x2 | x3 | x4 | x5 | x6 | x7 | x8 | Target |
|-----|----|----|----|----|----|----|----|----|--------|
| s1  | 1  | 1  | 1  | 1  | 1  | 1  | 1  | 0  | 1      |
| s2  | 1  | 1  | 1  | 1  | 1  | 1  | 2  | 0  | 1      |
| s3  | 1  | 1  | 1  | 1  | 1  | 2  | 2  | 0  | 1      |
| s4  | 1  | 1  | 1  | 1  | 2  | 2  | 2  | 0  | 0      |
| s5  | 1  | 1  | 1  | 1  | 2  | 2  | 2  | 1  | 1      |
| s6  | 0  | 0  | 2  | 2  | 2  | 2  | 0  | 2  | 2      |
| s7  | 0  | 0  | 2  | 2  | 2  | 2  | 0  | 2  | 0      |
| s8  | 0  | 2  | 2  | 2  | 2  | 2  | 1  | 1  | 1      |

| Target | No. | x1 | x2 | x3 | x4 | x5 | x6 | x7 | x8 |
|--------|-----|----|----|----|----|----|----|----|----|
| s17    | 1   | 1  | 1  | 2  | 1  | 2  | 2  | 0  |    |
| s18    | 1   | 2  | 2  | 2  | 2  | 2  | 2  | 1  |    |
| s19    | 1   | 2  | 1  | 1  | 1  | 2  | 2  | 1  |    |
| s20    | 2   | 2  | 2  | 0  | 0  | 0  | 0  | 2  |    |
| s21    | 2   | 1  | 1  | 1  | 1  | 1  | 1  | 2  |    |
| s22    | 2   | 2  | 0  | 0  | 0  | 0  | 2  | 2  |    |
| s23    | 2   | 1  | 1  | 2  | 1  | 2  | 2  | 1  |    |
| s24    | 1   | 2  | 2  | 1  | 2  | 1  | 1  | 1  |    |
given a value of 1 and on datasets using the different from the process of working with the small phase. then immediately do the examination because it could possibly have experienced symptoms of lupus in a negative (0). At the value of the symptom variable each is given data for 20 data and one more part will be used as test data for 10 data. Table 3 contains sample data to be trained and Table 4 contains samples of data to be tested.

Table 3. Training data

| No. | s1  | s2  | s3  | s4  | s5  | s6  | s7  | s8  | s9  | s10 | s11 | s12 | s13 | s14 | s15 | s16 | s17 | s18 | s19 | s20 |
|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|
| x1  | 1   | 1   | 1   | 1   | 1   | 1   | 1   | 2   | 1   | 1   | 2   | 1   | 1   | 2   | 1   | 1   | 1   |   |   |   |
| x2  | 1   | 1   | 1   | 1   | 1   | 1   | 2   | 1   | 2   | 1   | 2   | 1   | 2   | 1   | 2   | 1   |   |   |   |
| x3  | 1   | 1   | 1   | 1   | 1   | 1   | 2   | 2   | 2   | 2   | 1   | 2   | 1   | 1   | 1   | 1   | 2   | 1   |   |   |
| x4  | 1   | 1   | 1   | 1   | 1   | 2   | 2   | 2   | 2   | 1   | 2   | 1   | 2   | 1   | 2   | 1   | 1   |   |   |   |
| x5  | 1   | 1   | 1   | 1   | 2   | 2   | 2   | 2   | 2   | 2   | 1   | 2   | 2   | 1   | 1   | 2   | 1   |   |   |   |
| x6  | 1   | 1   | 1   | 2   | 2   | 2   | 2   | 2   | 1   | 2   | 1   | 1   | 1   | 2   | 1   | 1   | 2   |   |   |   |
| x7  | 1   | 1   | 2   | 2   | 2   | 2   | 2   | 2   | 1   | 2   | 2   | 2   | 2   | 2   | 2   | 2   |   |   |   |
| x8  | 1   | 2   | 2   | 2   | 2   | 2   | 2   | 2   | 1   | 1   | 2   | 2   | 1   | 2   | 1   | 1   |   |   |   |
| Target | 0   | 0   | 0   | 0   | 1   | 1   | 1   | 1   | 0   | 1   | 1   | 1   | 1   | 0   | 0   | 1   | 0   |   |   |   |

Table 4. Advanced training

|   | s1  | s2  | s3  | s4  | s5  | s6  | s7  | s8  | s9  | s10 |
|---|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|
| x1 | 2   | 2   | 2   | 1   | 1   | 2   | 1   | 2   | 1   | 1   |
| x2 | 1   | 2   | 1   | 1   | 2   | 1   | 2   | 1   | 2   | 2   |
| x3 | 1   | 1   | 1   | 1   | 2   | 1   | 2   | 1   | 2   | 1   |
| x4 | 1   | 1   | 2   | 1   | 1   | 2   | 2   | 1   | 1   | 1   |
| x5 | 1   | 2   | 1   | 1   | 1   | 1   | 2   | 2   | 1   | 2   |
| x6 | 1   | 1   | 2   | 2   | 1   | 2   | 2   | 2   | 1   | 2   |
| x7 | 1   | 1   | 2   | 1   | 1   | 2   | 2   | 1   | 1   | 1   |
| x8 | 2   | 2   | 1   | 1   | 2   | 1   | 2   | 1   | 2   | 1   |
| Target | 0   | 1   | 1   | 1   | 0   | 0   | 1   | 1   | 0   | 0   |

Based on existing data, this study has 8 input values and 2 output values, namely positive (1) and negative (0). At the value of the symptom variable each is given a value of 1 and 0, where 2 means experiencing these symptoms and 1 means no. If the patient feels 4 of the 8 symptoms that are present, then immediately do the examination because it could possibly have experienced symptoms of lupus in a small phase. The process of working on datasets using the Nguyen Widrow algorithm is not much different from the process of working with the Backpropagation algorithm. As we have already known,
Nguyen Widrow apply a scale factor $0.7 \left( p \right)^{1/n} = 0.7 \sqrt[n]{p}$ in the process of assigning weight values. In testing using all of the existing test data samples, it is expected to provide answers after the previous training process has been carried out for pattern recognition first.

3. Results and Discussion

This study focuses on predictions of lupus using the Nguyen Widrow algorithm weighting. In Table 5 is the result of the dataset training process using the Nguyen Widrow algorithm weighting. Table 5 explains that in the process of training data sets of weighting algorithms Nguyen Widrow with the initials activation function hidden = log sig, activation of log sig output, target error 0.1 and learning rate 0.1, Epoch 10000 it was found that recognizes 80 patterns. Table 6 contains a dataset of the results of the testing process using the Nguyen Widrow algorithm with the initial activation function hidden = logsig, activation of log sig output, target error 0.1 and learning rate 0.1, Epoch 10000 found that the Nguyen Widrow recognizes 100% patterns or 10 of existing patterns. While in Figures 1 and 2 are graphs of each testing process. Figure 1 graphs the accuracy of the percentage possessed by each data or pattern and in Figure 2 is the time graph of the test iteration process for each pattern. Result every pattern is $s_1 = 0.13$ second, $s_2 = 0.17$ second, $s_3 = 0.05$ second, $s_4 = 0.15$ second, $s_5 = 0.04$ second, $s_6 = 0.18$ second, $s_7 = 0.27$ second, $s_8 = 0.07$ second, $s_9 = 0.2$ second, $s_{10} = 0.21$ second.

| No. | s1 | s2 | s3 | s4 | s5 | s6 | s7 | s8 | s9 | s10 | s11 | s12 | s13 | s14 | s15 | s16 | s17 | s18 | s19 | s20 |
|-----|----|----|----|----|----|----|----|----|----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|
| x1  | 1  | 1  | 1  | 1  | 1  | 1  | 1  | 1  | 2  | 1   | 2   | 2   | 1   | 2   | 1   | 1   | 1   | 2   | 2   | 1   |
| x2  | 1  | 1  | 1  | 1  | 1  | 1  | 2  | 1  | 2  | 1   | 2   | 1   | 2   | 1   | 2   | 1   | 2   | 2   | 2   | 2   |
| x3  | 1  | 1  | 1  | 1  | 1  | 2  | 2  | 2  | 1  | 2   | 1   | 1   | 2   | 1   | 2   | 2   | 1   | 2   | 2   | 1   |
| x4  | 1  | 1  | 1  | 1  | 1  | 2  | 2  | 2  | 1  | 1   | 2   | 1   | 2   | 1   | 2   | 2   | 2   | 2   | 2   |
| x5  | 1  | 1  | 1  | 1  | 2  | 2  | 2  | 2  | 2  | 2   | 1   | 2   | 2   | 2   | 1   | 1   | 2   | 1   |
| x6  | 1  | 1  | 1  | 2  | 2  | 2  | 2  | 2  | 1  | 2   | 1   | 1   | 2   | 1   | 1   | 2   | 2   | 2   | 1   |
| x7  | 1  | 1  | 2  | 2  | 2  | 2  | 2  | 2  | 1  | 1   | 2   | 2   | 2   | 2   | 2   | 2   | 2   | 2   | 2   |
| x8  | 1  | 2  | 2  | 2  | 2  | 2  | 2  | 2  | 2  | 1   | 1   | 2   | 2   | 1   | 2   | 2   | 1   | 2   | 2   |

Table 5. Results of training

| Target | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 1 |
|--------|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| %      | 73 | 64 | 58.3 | 32.7 | 86 | 92 | 69 | 79 | 66 | 48 | 48.6 | 82 | 98 | 76.7 | 63.4 | 11.8 | 86.3 | 90.8 | 73.6 | 88.1 |

During training with several predetermined factors, it gives a fairly good percentage of pattern recognition. Of the 20 numbers of data that were trained there were 16 patterns that were correctly recognized. Frequent training processes and the large amount of data provided can later influence the results of the training and testing process.

| No. | s1 | s2 | s3 | s4 | s5 | s6 | s7 | s8 | s9 | s10 |
|-----|----|----|----|----|----|----|----|----|----|-----|
| x1  | 2  | 2  | 2  | 1  | 1  | 2  | 1  | 2  | 1   | 1   |
| x2  | 1  | 2  | 1  | 2  | 1  | 1  | 2  | 2  | 1   | 2   |
| x3  | 1  | 1  | 1  | 2  | 1  | 2  | 1  | 2  | 2   | 1   |
| x4  | 1  | 1  | 2  | 2  | 1  | 1  | 2  | 2  | 1   | 1   |
| x5  | 1  | 2  | 1  | 1  | 1  | 2  | 2  | 1  | 2   | 1   |
| x6  | 1  | 1  | 2  | 2  | 2  | 1  | 2  | 2  | 2   | 1   |
| x7  | 1  | 1  | 2  | 1  | 1  | 2  | 2  | 2  | 2   | 1   |

Table 6. Result result
In Table 6 the percentage value is a percentage of the ability to recognize patterns, each target pattern can be recognized very well above 50%.

| x8 | 2 | 2 | 1 | 1 | 2 | 1 | 2 | 1 | 1 | 0 | 0 |
|----|---|---|---|---|---|---|---|---|---|---|---|
| Target | 0 | 1 | 1 | 1 | 0 | 0 | 1 | 1 | 0 | 0 |
| % | 80.2 | 81.8 | 88.2 | 81.2 | 78.1 | 77.3 | 79.8 | 80.2 | 81.1 | 78.3 |

Figure 1. Graph accuracy

Figure 2. Graph time

4. Conclusions
This study of predicting lupus by using Nguyen Widrow long weighting algorithms uses 30 datasets. Based on the results of the training process, the initialization of Nguyen Widrow algorithm can range from 16 of the 20 datasets available. As for the results of the testing initialization Nguyen Widrow with the initial activation function, the target error 0.1 and learning rate 0.1, epoch 10000 able to recognize 100% of patterns from 10 existing datasets. So from that it can be concluded that the Nguyen Widrow Initialization algorithm has a good level of pattern recognition accuracy in making predictive processes.

Reference
[1] Eva Kurniasih, Rohmawati, Selviana, 2015, Faktor Yang Berhubungan dengan Gangguan Kulit Pada Masyarakat Di Desa Puguk Kecamatan Sungai Ambawang Kabupaten Kubu Raya Tahun 2015.
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