Prediction the Rice's Yield per acre using Backpropagation Algorithm

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Abstract

Nowadays, Neural Network technologies are applied in many fields. Neural Networks (NN) rely on the inner structure of available data sets rather than on comprehension of the modeled processes between inputs and outputs. Therefore, neural networks have been regarded as highly empirical models with limited extrapolation capability to situations outside the range of the training and validation data sets. This paper introduces the predict yield in describe field with neural network using backpropagation algorithm. This system is intended to compare the yield using training weights on all fields and the yield using training weights on each field.

Key words: neural network, backpropagation algorithm,

1. Introduction

In the past decade, two areas of search which have become very popular are the fields of neural networks (NNs) and backpropagation algorithm (BPAs). There are many kinds of neural network by now. Nobody knows exactly how many because new ones are invented every week. Neural networks are an information processing technique based on the biological nervous systems, such as the brain, process information.

Neural network is a useful for various applications that requires extensive categorization. Several applications of neural networks have been proven successful or partially successful in the areas of speech classification, character recognition, image compression, medical diagnosis, and financial and economic prediction.

The fundamental concept of neural networks is the structure of the information processing system. Composed of a large number of highly interconnected processing elements or neurons, a neural network system uses the human-like technique of learning by example to resolve problems. Neural networks can be used in various fields to model a given problem.

The main categorization of these methods is in the distinction between supervised and unsupervised learning. Supervised learning is with teacher and unsupervised learning is without teacher

Neural Network is used to predict yield while it is being communicated input data. This paper analyzes and studies with the most popular backpropagation algorithm. Based on analyze and by doing accuracy, runtime comparison between number of neuron in hidden layer.

The structure of this paper in as follows. Section 2 describes related works. Section 3 introduces the necessary background theory in this system. Section 4, overview of the system is presented. Finally we conclude the paper in Section 5.

2. Related work

In this section, the work in the literature related to this system is described.

Knowledge acquisition system represents the computerized system of rice production in Tanintharyi Division. which automatically provides the growth techniques of rice, the main points of view for production yield, production of insect, weather condition, types of rice, types of soil and upgrading growth rate effectively and systematically [3].

Serhiy Shtovba, Yakiv Mashnitskiy presented the prediction and selection a number of the potential customers of the insurance license with backpropagation multilayer feedforward neural network [5].

3. Background Theory

3.1 Neural Network

A neural network consists of a set of highly interconnected entities, called nodes or units. Each unit is designed to mimic its biological counterpart, the neuron. Each accepts a weighted set of inputs and responds with an output. A neural network is composed of such units and weighted unidirectional connections between them. In some neural nets, the number of units may be in the thousands. The output of one unit typically becomes an input for another. There may also be units with external inputs and/or outputs.

The biological metaphor for neural networks is the human brain. Like the brain, this computing

model consists of many small units that are interconnected. These units (or nodes) have very simple abilities. Hence, the power of the model derives from the interplay of these units. It depends on the structure of their connections.

The basic idea in neural nets is to define interconnected networks of simple units (let's call them "artificial neurons") in which each connection has a weight. Weight w_{ij} is the weight of the i^{th} input into unit j. The networks have some inputs where the feature values are placed and they compute one or more output values. The learning takes place by adjusting the weights in the network so that the desired output is produced whenever a sample in the input data set is presented.

A neural network is a set of connected input/output units where each connection has a weight associated with it. During the learning phase, the network learns by adjusting the weights so as to be able to predict the correct class of the input samples.

3.2 Architecture of Neural Network

The manner in which the neurons of a neural network are structure is intimately linked with the learning algorithm used to train the network. In general, there are five fundamentally different classes of network architectures.

3.2.1 Feed-Forward networks

Feed-Forward ANNs allow signals to travel one way only; from input to output. There is no feedback (loops i.e. the output of any layer does not affect that same layer. Feed-forward ANNs tend to be straight forward networks that associate inputs with outputs. They are extensively used in pattern recognition. This type of organization is also referred to as bottom-up or top-down.

3.2.2 Single layer Feed-forward Networks

Only-one feed-forward networks are often known as simple perceptrons. In the simplest form of a layered networks, we have an input layer of source nodes that projects onto an output layer of neuron (computation nodes), but not vice versa. In other words, this network is strictly a feed-forward type. Such a network is called a single layer network, with the designation “single-layer” referring to the output layer of computation nodes (neurons).

3.2.3 Multilayer Feedforward Networks

The second class of feedforward neural network distinguishes itself by the presence of one or more hidden layers, whose computation nodes are correspondingly called hidden neurons or hidden units. The function of hidden neurons is to intervene between the external input and the network output in some useful manner. By adding one or more hidden layers, the network is enabled to extract higher-order statistics. The source nodes in the input layer of the network supply respective elements of the activation pattern (input vector), which constitute the input signals applied to the neurons (computation nodes) in the second layer.

The output signals of the second layer are used as inputs to the third layer and so on for the rest of the network. Typically the neurons in each layer of the network have their inputs to get the desired signals of the preceding layer. The set of the output signals of the neurons in the output (final) layer of the network constitutes the overall response of the network to the activation pattern supplied by the source nodes in the input (first) layer. A multilayer feedforward is exactly equivalent to a simple-layer feedforward in the computation and the performance so such a network has the same limitations as a one layer feedforward network. The neural network in is said to be fully connected in the sense that ever node in each layer of the network is connected to every other node in that adjacent forward layer.

3.2.4 Feedback Networks

Feedback networks can has signals travelling in both directions by introducing loops in the network. Feedback networks are very powerful and can get extremely complicated. Feedback networks are dynamic; their state is changing continuously until they reach an equilibrium point. They remain at the equilibrium point until the input changes and a new equilibrium needs to be found. Feedback architecture is also referred to as interactive or recurrent, although the latter term is often used to denote feedback connections in single layer organizations.

3.2.5 Recurrent Networks

A recurrent network distinguished itself from a feedfroward neural network in that it has at least one feedback loop. For example, a recurrent network may consist of a single layer of neurons with each neuron feeding its output single back to the other neurons. The recurrent network also no hidden neurons. There are no self-feedback loops in the network; self-feedback refers to a situation where the output of a neuron is fed back into own input. Two types of recurrent networks are Elman and Hopfield networks.

3.3 Network layers

The commonest type of artificial neural network consists of three groups, or layers, of units: a layer of "**input**" units is connected to a layer of "**hidden**" units, which is connected to a layer of

"**output**" units. (see Figure 1)

The activity of the input units represents the raw information that is fed into the network.

The activity of each hidden unit is determined by the activities of the input units and the weights on the connections between the input and the hidden units.

The behaviour of the output units depends on the activity of the hidden units and the weights between the hidden and output units.

This simple type of network is interesting because the hidden units are free to construct their own representations of the input. The weights between the input and hidden units determine when each hidden unit is active, and so by modifying these weights, a hidden unit can choose what it represents.

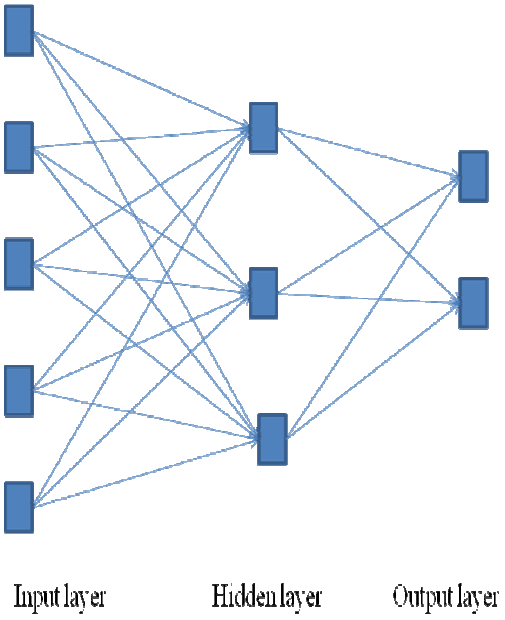

Figure.1 An example of a simple feedforward network

3.4 Backpropagation Algorithm

Backpropagation Algorithm is a supervised learning procedure which involves the representation of a set of pairs of input and output patterns. The system first uses the input data to produce its own output and then compared this with the desired output or the target value. If there is no different, then no learning takes place. Otherwise the weights are changed to reduce the difference.

This algorithm has two phases. First, a training input pattern is presented to the network input layer. The network propagates the input pattern from layer to layer until the output is generated by the output layer. If this pattern is different from the desired output, an error is calculated and then propagated backward through the network from the output layer to the input layer. The weights are modified as the error is propagated. According to the Richard P. Lippmann [1], he represents step of the backpropagation training algorithm and explanation. The backpropagation training algorithm is an iterative gradient designed to minimize the mean square error between the actual output of multi-layer feed forward perceptrons and the desired output. It requires continuous differentiable non-linearity. The following assumes a sigmoid logistic nonlinearity.

Step 1: Initialize weights and offsets

Set all weights and nodes offsets to small random values.

Step 2: Present input and desired outputs

Present a continuous valued input $X_0, X_1, X_2,$ ---- X_{N-1} and specify the desired output $d_1, d_2,$ ---- d_{M-1}.

Step 3: Calculate Actual Output

Use the sigmoid activation function to get net input (net_j) and net output (y_j) of each neuron in hidden and output layers. Actual output is net output of output neuron.

$$net_j = w_0 + \sum_{i=1}^{n} x_i \, w_{ij}$$

$$y_j = \frac{1}{1 + e^{(-net_j)}}$$

In this equation w_{ij} is the weight from input node i to hidden node j or hidden node i to output node j.

Step 4: Adapt weights

Use a recursive algorithm starting at the output nodes and working back to the first hidden layer. Adjust weights by

$$w_{ij}(t+1) = w_{ij}(t) + \eta \, \delta_j \, x_i$$

In this equation $w_{ij}(t)$ is the weight from hidden node i or from an input to node j at time t, x_i, is either the output of node i or is an input, η is the gain tern, and δ_j, is an error term for node j, if node j is an output node, then

$$\delta_j = y_j (1 - y_j)(d_j - y_j)$$

where d_j is the desired output of node j and y_j is the actual output.

If node j is an internal hidden node, then

$$\delta_j = x_j (1 - x_j) \sum_k \delta_j \, w_{jk}$$

where k is over all nodes in the layers above node j.

Internal node thresholds are adapted in a similar manner by assuming they are connection weights on links from auxiliary constant-valued inputs. Convergence is sometimes faster if a momentum term is added and weight change are smoothed by

$$w_{ij}(t+1) = w_{ij}(t) + \eta \delta_j \, x_i + \alpha (w_{ij}(t) - w_{ij}(t-1))$$

where $0 < \alpha < 1$.

Step 5: Repeat by going to step 2

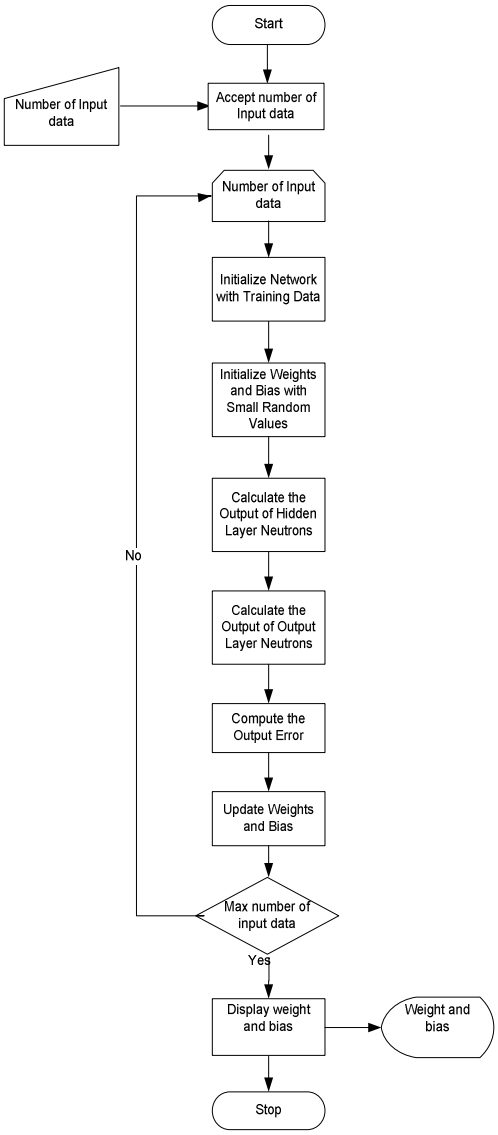

Figure.2 System Flow of the Neural Network weights by using Backpropagation Algorithm [7]

4. System Overview

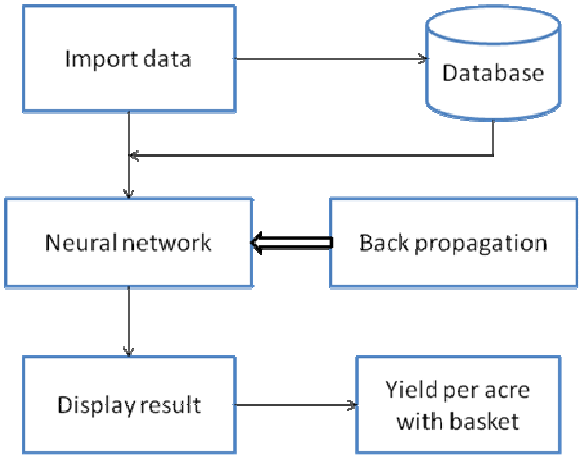

Figure.3 Block diagram of the system

In this system must have eight input data. They are field type (FT), Crop type (CT), Cultivate of type (COT), amount the usage of Natural fertilizer (NF), Pearl fertilizer (PF) and other fertilizer (OF), insecticide (I) and machine usage (MU). At the beginning, these input training data set inputted from Database. Then the training dataset train in neural network with Backpropagation Algorithm and then display yield per acre (YPA) with basket. So, the yield for first field in the field type will be decreased other field because this soil was contained highly sandy loam. Fertilizer must consist of 75 kilogram Pearl, 13 kilogram Compound for one acre. The accuracy of the prediction process is calculated based on the percentage of correctly identified outputs. Prediction accuracy is the most important measure of system performance.

Simplified neural network architecture for this system is shown in Figure 3.

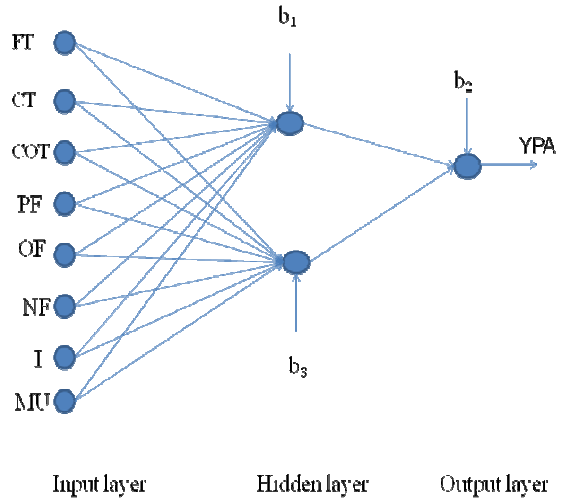

Figure.4 Simplified neural network architecture for this system

Table.1 Field Type

Parameter	Value
Sarrmalouk	1
Moemakha	2
Kunchankone	3
kunchankoneS	4
Walngal	5

The field type of this system has five parameters. The values of this parameter defined yield of the field are the different soil according to the record data

Table.2 Crop Type

Parameter	Value
Manawthuka	93
Sainethuka	92
Ayarmin	82
Sainethwelatt	95
Mawbisan	75
Shwewartun	86
Theethatyin	81
Sainenweyin	79

The crop type this system has eight parameters. The values of this parameter are defined by highest yield in the record data.

Table.3 Cultivated Type

Parameter	Value
Sow seeds	0.5
Scatter seeds	0.01

The cultivated of type has two parameter. The values of this parameter are defined by on the waste of the rice seed in the cultivated method.

Table.4 Machinery Usage

Parameter	Value
Harrow	100
Reap	10
No use	1
Use	1000

The machinery usage of the system has four parameters. These values are defined with the yield when during the time harrow and reap using machine.

5. Experimental results

In this paper, eight input datas are chosen by user. According to the input datas, the output values are active as follow:

Field Type : Kunchankone
Crop Type : Manawthuka
Cultivate of Type : Sow seeds to get seedings
Pearl Fertilizer (gram) : 12500
Other Fertilizer (gram) : 0
Natural Fertilizer (gram): 643000
Insecticide : 0
Machine usage : none

According to the above inputs, the output values are showed as follow:
All field type (basket) : 53
For one field (basket) : 74

In the experiment, three different numbers of hidden neurons have been used and results are shown in Table 5. The correct identification is 75% and incorrect identification is 25% in two hidden neurons, the correct identification is 83% and incorrect identification is 17% in three hidden neurons and the correct identification is 80% and incorrect identification is 20% in four hidden neurons, respectively.

Table.5 Accuracy of Different Hidden Neurons

Number of Hidden Neurons	Correct Identification	Incorrect Identification
2	75%	25%
3	83%	17%
4	80%	20%

6. Conclusion

In this paper, a neural network approach has been proposed for the rice's yield prediction with backpropagation algorithm. We are trained Neural network in this system will be received six pairs of weight for all field type in the database and every field type in the database. So, this system can produce two results on the same input data. The optimal result can be easily seen and compare this two result. This system will be closely predicted yield of predefine field type. This will not suitable predicted yield for another field type. This system will produce accuracy based on the hidden neurons count and error rate.

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