

A Survey on Crop Prediction using Back Propagation Neural Network

Nidhi Gupta¹, Nalini Mittal², Aditi Gulati³, Kamal Chhabra⁴
^{1,2,3}ECE Department, ⁴CSE Department, GITM, Bilaspur
¹nids.gupta112@gmail.com, ²nmnalini7@gmail.com

Abstract-The aim of this research is to develop a farmer prediction system to identify crop suitable for particular soil. To achieve this Neural Network should be trained to perform correct prediction for farmers. After the network has been properly trained, it can be used to identify the crop suitable for particular type of soil. The Artificial neural networks are relatively crude electronic networks of "neurons" based on the neural structure of the brain. It process the records one at a time, and "learn" by comparing their prediction of the record with the known actual record. The errors from the initial prediction of the first record is fed back into the network, and used to modify the networks algorithm the second time around and so on for many iterations. An improved Back Propagation Neural Network model with improved learning algorithm provides an effective prediction tool for agriculture crops forecasting.

Keywords-Neural Network, Back Propagation, Learning algorithm, Training.

1. Introduction

Information packaged in sizeable databases about all kinds of characteristics and facets are accessible these days. Extracting new and interesting knowledge through interpreting the collected data is cumbersome since more data potentially contains more information. To analyze these databases, immense efforts are being deployed. Understanding the hidden are implicit relationship between attributes in these Knowledge Discovery Databases (KDD) requires data mining techniques, as it has been proven as an effective tool. Data mining in nutshell is, pattern finding. Data mining is the process of discovering previously unknown and potentially interesting patterns in large dataset. The modal of the semantic structure of the dataset is obtained and represented from the mined information tasks such as prediction or classification utilizes this model. Finding patterns and elucidating those patterns clearly are the two primary activities of data mining. Facilitating to make profitable predictions through offering insights into the data and providing proper explanations about the data is the mark of efficient data mining tool. The primary intent of this research is to find a solution that could provide a near precise information on the suitability of crop(s) for a given soil type. Agriculture and allied activities constitute the single largest component of India's gross domestic product, and contributed nearly 25% of the total and nearly 60% of Indian population depends on this profession. Neural networks, despite the presence of considerable noise in the training set, have the ability to trace the hidden and strongly non-linear dependencies and once the training is completed, is an appropriate tool when it comes to prediction.

An artificial neural network (ANN), usually called neural network is a mathematical model or computational model that is inspired by the structure and/or functional aspects of biological neural networks. A neural network consists of an interconnected group of artificial neurons, and it processes information using a connectionist approach to computation. Modern neural networks are non-linear statistical data modeling tools. They are usually used to model complex relationships between inputs and outputs or to find patterns in data. In feed-forward neural networks the neurons of the first layer drive their output to the neurons of the second layer, in a unidirectional manner, means the neurons are not received from the reverse direction. Multilayer Perceptron Neural Networks (MLPNN) or Multilayer Feed-forward Neural Network (MFNN) is one such feed-forward neural network mechanism.

Incorporating three layers, input, output and intermediate, the MLPNN designates distinct roles for each. Input layer maintains equal number of neurons corresponding to that of the variables in the problem. The output layer comprises a number of neurons equal to the preferred number of quantities, computed from the input and makes accessible the perceptron responses. The intermediate/hidden layer takes care of approximating non-linear problems. Processing linear problems necessitate the presence of only the input and output layer of the MLPNN. Data having discontinuities like saw tooth wave pattern necessitate the presence of two hidden layers for prototyping. The risk of congregating to local minima is greater while using two hidden layers and it seldom refines the model. Hypothetical rationale behind implementing more than two hidden layers is also void. Separate weights are applied to the sums forwarded to each layer while the output from the first hidden layer is fed to the input of the next hidden layer, in scenarios where more than one hidden layers are deployed. The approach fostered by us employs a network with two hidden layers. A general structure of MLPNN comprising three layers is shown in Fig.1

The only task of the neurons in the input layer is to distribute the input signal x_i to neurons in the hidden layer. Each neuron j in the hidden layer sums up its input signals x_i after weighting them with the strengths of the respective connections w_{ji} from the input layer and computes its output y_j as a function f of the sum, given by:

$$Y_j = f(\sum W_{ji} X_i)$$

Where f can be a simple threshold function such as a sigmoid, or a hyperbolic tangent function. The output of neurons in the output layer is computed in the same manner. Following this calculation, learning algorithm is used to adjust the strengths of the connections in order to allow a network to achieve a desired overall behavior. There are many types of learning algorithms in the literature.

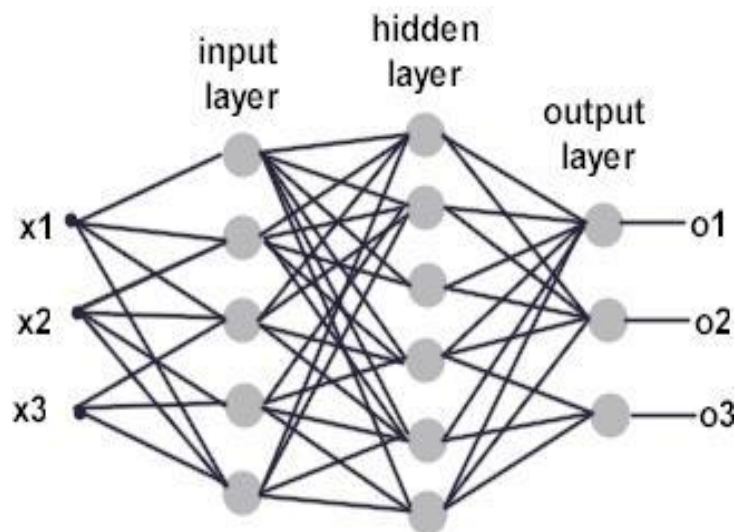


Fig. 1 Basic Neural Network

Back propagation is a common method of training artificial neural networks so as to minimize the objective function. Arthur E. Bryson and Yu-Chi Ho described it as a multi-stage dynamic system optimization method in 1969. It is a supervised learning method, and is a generalization of the delta rule. It requires a dataset of the desired output for many inputs, making up the training set. It is most useful for feed-forward networks (networks that have no feedback, or simply, that have no connections that loop). The term is an abbreviation for "backward propagation of errors". Back propagation requires that the activation function used by the artificial neurons (or "nodes") be differentiable. For better understanding, the back propagation learning algorithm can be divided into two phases: propagation and weight update.

A. Phase 1: Propagation

Each propagation involves the following steps:

- 1) Forward propagation of a training pattern's input through the neural network in order to generate the propagation's output activations.
- 2) Backward propagation of the propagation's output activations through the neural network using the training pattern's target in order to generate the deltas of all output and hidden neurons.

B. Phase 2: Weight update

For each weight-synapse follow the following steps:

- 1) Multiply its output delta and input activation to get the gradient of the weight.
- 2) Bring the weight in the opposite direction of the gradient by subtracting a ratio of it from the weight.

This ratio influences the speed and quality of learning; it is called the learning rate. The sign of the gradient of a weight indicates where the error is increasing; this is why the weight must be updated in the opposite direction. The back propagation algorithm for calculating a gradient has been rediscovered a number of times, and is a special case of a more general technique called automatic differentiation in the reverse accumulation mode.

2. Related study

Pang et. al. [1] established a neural network credit-risk evaluation model by using back-propagation algorithm. The model is evaluated by the credits for 120 applicants. The 120 data are separated in three groups: a "gwd credit" group,

a “middle credit” group and a “had credit” group. The simulation shows that the neural network credit-risk evaluation model has higher classification accuracy compared with the traditional parameter statistical approach that is linear discriminate analysis. We still give a learning algorithm and a corresponding algorithm of the model.

Chung et.al [2] presented a new back-propagation neural network (BPN) training algorithm performed with an ant colony optimization (ACO) to get the optimal connection weights of the BPN. The concentration of pheromone laid by the artificial ants moving on the connection path is the key factor of the optimal weight determination. This is the metaphor that the optimal weights make the "total length of neuron-to-neuron connections traversed by all artificial ants," which is defined by the BPN output values and the target values of the proposed ant-based BPN, be the shortest. The generalization ability of the proposed ant-based BPN was checked by means of approximating two functions, a statistic standard normal distribution $N(0, 1)$ and a $\sin(x)$ function, and demonstrated by comparing it to that of a standard BPN. Surprisingly, the superiority of the ant-based BPN's generalization ability in terms of both the statistical determination coefficient and the means square error is beyond the expectation.

Song et. al. [3] aimed at designing an intelligent and carry-home diagnosis expert system (ES) to help inexpert farmers detect crop nutrition disorders in time. To ensure the reasoning veracity of the system, artificial neural networks (ANN) were proposed, and a single chip computer was applied for spot using possibility. Two subsystems and their corresponding ANN clusters were created according to the location where the nutrition disorders first took place. The symptoms of six crops were collected. The confidences and conclusions of symptoms diagnosis by field experts were used as input and output neurons of ANN. Study results were saved as a knowledge base in a flash memory. Using MCS-51C language, single chip computer diagnosis was realized. Field validation indicated that diagnosis errors were less than 8%. Moreover, the combination of ANN and ES can make up traditional expert system defects and improve the systems intelligence and diagnosis efficiency.

Gill et. al. [4] accuated weather forecasting is important in today's world as agricultural and industrial sectors are largely dependent on the weather conditions. Secondly, it is used to warn about natural disasters. Due to non-linearity in climatic physics, neural networks are suitable to predict these meteorological processes. Back Propagation algorithm using gradient descent method is the most important algorithm to train a neural network for weather forecasting. Back propagation algorithm suffers from several problems. In this paper, in order to overcome some of these problems, an integrated back propagation based genetic algorithm technique to train artificial neural networks is proposed. In the proposed technique, back propagation is combined with genetic algorithm in such a way that the pitfalls of the algorithm get converted to benefits. The results and comparison of the technique with the previous one are enlisted along with.

Zhang et. al. [5] proposed a new hybrid forecasting model for the prediction of ozone concentrations in semi-arid area. It is based on chaotic, particle swarm optimization algorithm (CPSO) and back propagation (BP) neural network, called CPSO-BP neural network. The results show that the proposed hybrid model is superior to both the BP neural network and the regression model being tested. The hybrid model achieves 18.7% in root mean square error reduction compared to BP model, and 8.1% reduction compared to stepwise regression model. It could be a promising model on forecasting ozone concentration in semi-arid area.

Panchalet. al. [6] identified potential employees who are likely to stay with the organization during the next year based on previous year data. Neural networks can help organizations to properly address the issue. To solve this problem a neural network should be trained to perform correct classification between employees. After the network has been properly trained, it can be used to identify employees who intent to leave and take the appropriate measures to retain them.

Shresthaet. al. [7] recently proposed Extreme Learning Machine (ELM) version of ANN which is extremely fast and does not require any iterative learning is introduced. In ELM classifier, only number of neurons required has to be fine-tuned unlike numerous parameters in MLP. To disseminate, its use to wider audience in remote sensing field, its implementation in MATLAB in a Graphical User Interface (GUI) is described. The developed GUI is capable of handling large image files by employing a smarter technique of supplying rectangular chunk of image data through object oriented image adapter class and provides a simple and effective computation environment for performing ELM classification with accuracy assessment.

Minghuaet. al. [8] proposed the prices of agricultural products are affected by many factors and the relationship between independent variables and dependent variables can not use specific mathematical formula to express. The traditional prediction methods emphasized on the linear relationship between the prices, and the limitation is apparent, which lead to the low prediction precision. This paper proposes an improved BP neural network model. Firstly, get factors of price fluctuation of agricultural products through the qualitative analysis and then use the MIV method to choose the strong influent factors as the input nodes of a neural network. Find the optimal structure of BP network through the improved learning algorithm, and then use the improved model to realize the agricultural high precision simulation of the product price. The results show that, the model provides an effective prediction tool for the

agricultural product price forecasting.

Wenwen et. al. [9] presented a new prediction model, which combines the clustering with neural network. The existed clustering algorithm has the shortcoming that can not determine the clustering number K, so this paper combines it with the concept of rough set to improve, and tests it on the IRIS data; Then author presents the new forecasting model which combines improved clustering algorithm and neural networks to improve the prediction accuracy more effectively, and tests it in statistics data.

Zecchin et. al. [10] proposed an algorithm for short-time glucose prediction using past CGM sensor readings and information on carbohydrate intake. The predictor combines a neural network (NN) model and a first-order polynomial extrapolation algorithm, used in parallel to describe, respectively, the nonlinear and the linear components of glucose dynamics. Information on the glucose rate of appearance after a meal is described by a previously published physiological model. The method is assessed on 20 simulated datasets and on 9 real Abbott Freestyle Navigator datasets, and its performance is successfully compared with that of a recently proposed NN glucose predictor. Results suggest that exploiting meal information improves the accuracy of short-time glucose prediction.

3. Conclusion

Back Propagation Neural Network, Neuron Model and problems of basic BP algorithm and improved BP Neuron model has been studied. Predicting is making claims about something that will happen, often based on information from past and from current state. Neural networks can be used for prediction with various levels of success. The advantage of then includes automatic learning of dependencies only from measured data without any need to add further information (such as type of dependency like with the regression). The neural network is trained from the historical data with the hope that it will discover hidden dependencies and that it will be able to use them for predicting into future. By harnessing the latest advances in artificial intelligence and neural network technology, more advance and fast prediction can be made.

References

- [1] Rong-Zhou Li, Su-Lin Pang, Jian-Min Xu, "Neural Network Credit-Risk Evaluation Model based On Back-Propagation Algorithm" IEEE, Nov 2002.
- [2] Jeng-Bin Li and Yun-Kung Chung, "A Novel Back-propagation Neural Network Training Algorithm Designed by an Ant Colony Optimization" IEEE, 2005.
- [3] Haiyan Song and Yong He "Crop Nutrition Diagnosis Expert System Based on Artificial Neural Networks" IEEE, 2005.
- [4] Er. Jasmeen Gill, Er. Baljeet Singh and Er. Shaminder Singh, "Training Back Propagation Neural Networks with Genetic Algorithm for Weather Forecasting" IEEE, Sept, 2010.
- [5] Wen-Yu Zhang, Zhen-HaiGuo, Xin Liu and Jian-Zhou Wang, "Prediction of Ozone Concentration Using Back Propagation Neural Network with a Novel Hybrid Training Algorithm" IEEE, 2010.
- [6] GaurangPanchal, AmitGanatra, Y.P. Kost and DevyaniPanchal, "Forecasting Employee Retention Probability using Back Propagation Neural Network Algorithm" IEEE, 2010.
- [7] ShaileshShrestha, ZbigniewBochenek and Claire Smith, "Artificial Neural Network (Ann) Beyond Cots Remote Sensing Packages: Implementation of Extreme Learning Machine (Elm) In Matlab" IEEE, 2012.
- [8] Wei Minghua, Zhou Qiaolin, YangZhijian and ZhengJingui, "Prediction Model of Agricultural Product's Price Based on the Improved BP Neural Network" IEEE, 2012.
- [9] Wang Zuo, Sun Wenwen, Li Jingyong and Wang Zhe, "Prediction Model in Statistics Data Based on Improved Cluster and Neural Network" IEEE, 2012.
- [10] Chiara Zecchin, Andrea Facchinetti, Giovanni Sparacino, Giuseppe De Nicolao and Claudio Cobelli, "Neural Network Incorporating Meal Information Improves Accuracy of Short-Time Prediction of Glucose Concentration," IEEE Transactions on Biomedical Engineering, Vol. 59, No. 6, June 2012