Network and Complex Systems
ISSN 2224-610X (Paper) ISSN 2225-0603 (Online)
Vol.5, No.2, 2015

Pattern Recognition Neural Network and Class of Grades

Ojuawo olutayo Oyewole
Department of Computer Science, Federal Polytechnic Ilaro
Teemana2000@yahoo.com;

Olaiju O.A
Department of Mathematics and Statistics, Federal Polytechnic Ilaro
olaiju@yahoo.com

Afolayan O
Department of Science Laboratory Technology, Federal Polytechnic, Ilaro

Abstract
We investigated the ability of neural network to recognise pattern by using pattern recognition neural network tool box to predict the class of Science laboratory technology students in Federal polytechnic Ilaro. A total final results of 431 students of the department between 2005 and 2010 was used. The data contained results of ten courses offered by the students together with their GPA and the grade of each student. The marks scored by 420 students in each course together with the grade obtained in each course were used for training, testing and validation of the neural network. 11 student's data were used for prediction purpose. We used a two-layer feed-forward network, with sigmoid hidden and output neurons (newpr), which can classify vectors arbitrarily well, given enough neurons in its hidden layer. The network was trained with scaled conjugate gradient backpropagation (trainscg). The marks scored by 294(70%) students in each course together with the grade obtained in each course were used for training, 63(15%) for testing and 63(15%) for validation of the neural network. The Grade were classified into five categories: Probation, Pass, lower credit, Upper credit and Distinction. We predict the type of grade based on scores of the students in each course. The training, validation and test were performed with different neuron numbers in the hidden layer i.e 20,15, 10 and 5 neurons. The results showed that among the ANN models, ANN 20 performed best with MSE= 1.511623803293947e-07 and Confusion= 0.061224489795918 followed by ANN 5 with MSE=1.804838395630207e-07 and Confusion= 0.052721088435374. Our research showed clearly that Neural network pattern recognition tools can predict student grade perfectly well if given enough data to train.
Keywords: Pattern recognition, training, validation, neuron, confusion matrix

Introduction

Artificial neural networks are inspired by the early models of sensory processing by the brain. An artificial neural network can be created by simulating a network of model neurons in a computer. By applying algorithms that mimic the processes of real neurons, we can make the network 'learn' to solve many types of problems (Anders Krogh (2008)). A model neuron is referred to as a threshold unit . It receives input from a number of other units or external sources, weighs each input and adds them up. If the total input is above a threshold, the output of the unit is one; otherwise it is zero. Therefore, the output changes from 0 to 1 when the total weighted sum of inputs is equal to the threshold. The points in input space satisfying this condition define a so called hyperplane (Anders Krogh (2008)). In two dimensions, a hyperplane is a line, whereas in three dimensions, it is a normal plane. Points on one side of the hyperplane are classified as 0 and those on the other side as 1. It means that a classification problem can be solved by a threshold unit if the two classes can be separated by a hyperplane. Such problems are said to be linearly separable .

In this paper we show the ability of neural network in recognising pattern by using pattern recognition neural network tool box to predict the class of grades of SLTstudents in Federal polytechnic Ilaro.

Related works

Rama Kishore, Taranjit Kaur (2012) In the paper Backpropagation Algorithm: An Artificial Neural Network Approach for Pattern Recognition summarized the methods used in various stages of a pattern recognition system and identify the best suitable technique with its advantages over other techniques to recognize the complex patterns along with other real-life applications.

Jayanta Kumar Basu1, Debnath Bhattacharyya2, Tai-hoon Kim2 (2010) in their review paper 'Use of Artificial Neural Network in Pattern Recognition' summarized and compare some of the well-known methods used in various stages of a pattern recognition system.

Kunihiko fukushima (1987), discussed the mechanism of the neocognitron model previously proposed in detail. In order to demonstrate the ability of the neocognitron, they also discussed a pattern-recognition system

which works with the mechanism of the neocognitron. The system was implemented on a minicomputer and was trained to recognize handwritten numerals.

Hafiz T. Hassan, Muhammad U. Khalid and Kashif Imran(2010) incorporated Back Propagation Neural Network for the classification of two datasets (the sonar and ionosphere datasets) in bagging ensemble architecture using PCA and standalone architecture.

Son Lam Phung, A. Bouzerdoum (2007) proposed a new neural architecture for classification of visual patterns that is motivated by the two concepts of image pyramids and local receptive fields. The new architecture, called pyramidal neural network (PyraNet), has a hierarchical structure with two types of processing layers: Pyramidal layers and onedimensional

(1-D) layers. In the new network, nonlinear two-dimensional (2-D) neurons were trained to

perform both image feature extraction and dimensionality reduction. they presented and analyzed five training methods for PyraNet [gradient descent (GD), gradient descent with momentum, resilient backpropagation (RPROP), Polak-Ribiere conjugate gradient (CG), and Levenberg-Marquadrt (LM)] and two choices of error functions [mean-square-error (mse) and cross-entropy (CE)]. They also apply PyraNet to determine gender from a facial image, and compare its performance on the standard facial recognition technology (FERET) database with three classifiers: The convolutional neural network (NN), the k-nearest neighbor (k-NN), and the support vector machine (SVM).

Dumitru Erhan, Christian Szegedy, Alexander Toshev, and Dragomir Anguelov(2012) proposed a saliency-inspired neural network model for detection, which predicts a set of class-agnostic bounding boxes along with a single score for each box, corresponding to its likelihood of containing any object of interest. The model naturally handles a variable number of instances for each class and allows for crossclass generalization at the highest levels of the network. They were able to obtain competitive recognition performance on VOC2007 and ILSVRC2012, while using only the top few predicted locations in each image.

Nilesh Y. Choudhary, Mrs. Rupal Patil, Dr. Umesh. Bhadade, Prof. Bhupendra M Chaudhari, (2013) proposed off-line signature recognition & verification using back propagation neural network. They verified Signatures based on features extracted from the signature using Invariant Central Moment and Modified Zernike moment for its invariant feature extraction because the signatures are Hampered by the large amount of variation in size, translation and rotation and shearing parameter..The signature recognition& verification system was designed using MATLAB. The work was tested and found suitable for its purpose.

Organization

We select the Input and target that define our problem. We have 3 sets of sample data in performing the simulation to create the model

Training data : These are presented to the network during training, and the network is adjusted according to its error

Validation data: These are used to measure network generalization, and to halt training when generalization stops improving.

Testing data: These are presented to the network during training, and the network is adjusted according to its error.

The best ANN model was selected using two performance measure, the mean squared error and percent error.

Percent Error (Confusion value) indicates the fraction of samples which are misclassified. A value of 0 means no misclassifications, 100 indicates maximum misclassifications.

Mean Squared Error is the average squared difference between outputs and targets. Lower values are better. Zero means no error.

Training automatically stops when generalization stops improving, as indicated by an increase in the mean square error of the validation samples.

Data Collection

The student results publication of 431 students issued by the MIS department of Federal polytechnic Ilaro of the 2005 and 2010 ND students of SLT department of the institution containing results of ten causes offered by the students together with their GPA and the grade of each student were obtained from the department.

Methods

The Neural Network Pattern Recognition Tool of MATLAB 7.6.0 (R2008a) helped us select data, create and train a network, and evaluate its performance using mean square error and confusion matrices.

We used a two-layer feed-forward network, with sigmoid hidden and output neurons (newpr), which can classify vectors arbitrarily well, given enough neurons in its hidden layer.

The network was trained with scaled conjugate gradient backpropagation (trainscg). The marks scored

by 294(70%) students in each cause together with the grade obtained in each cause were used for training, 63(15%) for testing and 63(15%) for validation of the neural network. 11 separate students data were used for prediction purpose.

The Grade were classified into five categories: Probation, Pass, lower credit, Upper credit and Distinction

We predict the type of grade based on scores of the students in each course.

The data set consists of 420 samples.

"scores input" is a 10x420 matrix whose rows are

1. Plant and animal taxonomy (STB 111)
2. Morphology and Physiology of living Organism (STB 112)
3. General Principle of Chemistry(STC111)
4. Inorganic Chemistry(STC112)
5. Mechanics(STP111)
6. Heat Energy (STP 112)
7. Logic and Linear algebra II (MTH 121)
8. General Laboratory Techniques (GLT 111)
9. Citizenship Education I (GNS111)

10 Cell Biology (ICT103)

"Course Targets" is a 5x420 matrix, where each column indicates the correct category with a 1 in one element (and a zero in the other).whose rows are:

1 Probation
2 Pass
3 Lower Credit
4 Upper Credit
5 Distinction

The training, validation and test were performed with different neuron numbers in the hidden layer i.e 20, 15, 10 and 5 neurons. The results were given in the tables 1,2,3 and 4 below.

The results showed that among the ANN models, ANN 20 performed best with MSE= 1.511623803293947e-07 and Confusion= 0.061224489795918 followed by ANN 5 with MSE=1.804838395630207e-07 and Confusion= 0.052721088435374

Results

The following tables are the results of the four ANN models together with the prediction performance of ANN 20 model

Epoch 127 ANN 20

	Sample	MSE	Confusion
Training	294	1.511623803293947e-07	0.061224489795918
Validation	63	1.977502350500497e-07	0.063492063492063
Testing	63	3.510786001355167e-07	0.031746031746032

Table1: ANN 20 performance

Epoch 107 ANN 15

	Sample	MSE	Confusion
Training	294	1.680675345938007e-07	0.054421768707483
Validation	63	1.944389833625995e-07	0.055555555555556
Testing	63	2.196896426486763e-07	0.071428571428571

Table2: ANN 15 performance

Epoch 126 ANN 10

	Sample	MSE	Confusion
Training	294	0.090136263778676	0.420068027210884
Validation	63	0.095238231176427	0.428571428571429
Testing	63	0.079365625944413	0.373015873015873

Table 3: ANN 10 performance

Epoch278 ANN 5

	Sample	MSE	Confusion
Training	294	1.804838395630207e-07	0.052721088435374
Validation	63	2.243867999681988e-07	0.063492063492063
Testing	63	1.533306478423771e-07	0.071428571428571

Table 4: ANN 5 performance

Students Mat No	GPA	Probation	Pass	Lower Credit	Upper Credit	Distinction
N/ST/10/1315	2.81	0.0000	0.0000	1.0000	0.0000	0.0000
N/ST /10/1316	2.67	0.0000	0.0000	1.0000	0.0000	0.0000
N/ST /10/1317	1.69	1.0000	0.0001	0.0000	0.0000	0.0000
N/ST /10/1318	2.57	0.0000	0.0007	0.9981	0.0000	0.0000
N/ST /10/1319	2.06	0.0000	0.9992	0.0000	0.0000	0.0000
N/ST /10/1320	3.14	0.0000	0.0000	0.0000	0.0000	0.9999
N/ST /10/1321	2.9	0.0000	0.0000	1.0000	0.0000	0.0000
N/ST /10/1322	2.21	0.0000	1.0000	0.0000	0.0000	0.0000
N/ST /10/1323	1.77	1.0000	0.0000	0.0000	0.0000	0.0000
N/ST /10/1324	2.39	0.0000	1.0000	0.0000	0.0000	0.0000
N/ST /10/1315	2.25	0.0000	1.0000	0.0000	0.0000	0.0000

Table 5: prediction performance of ANN 20 model

Table 5 showed the prediction performance of ANN 20 .Since the values in cell(3,3) and cell(4,3) are very closed to 0 we approximate their values to 0 and also the vales at cell(5,3), cell(4,5) and cell(6,6) are close to 1 so they can be approximated to 1. Thus with all that fixed we see that the model categorised the grades perfectly well.

Conclusion and recommendation

Neural network pattern recognition tools can predict student class perfectly well if given enough data to train.

Both the simple perceptron with a single unit and the multi-layer network with multiple units can easily be generalized to prediction of more than two classes by just adding more output units. Any classification problem can be coded into a set of binary outputs

Neural networks have been applied to many interesting problems in different areas of science, medicine and engineering and in some cases, they provide state-of-the-art solutions. Neural networks have sometimes been used haphazardly for problems where simpler methods would probably have given better results, giving them a somewhat poor reputation among some researchers. There are other types of neural networks than the ones described here, such as Boltzman machines, Supervised networks and Kohonen nets. Support vector machines are closely related to neural networks.

References

Anders Krogh (2008). What are artificial neural networks? Primer, nature biotechnology volume 26 number 2 February, 2008

Rama Kishore, Taranjit Kaur (2012) , Backpropagation Algorithm: An Artificial Neural Network Approach for Pattern Recognition International Journal of Scientific & Engineering Research, Volume 3, Issue 6, ISSN 2229-5518

Nilesh Y. Choudhary, Mrs. Rupal Patil, Dr. Umesh. Bhadade, Prof. Bhupendra M Chaudhari, (2013), Signature Recognition & Verification System Using Back Propagation Neural Network . International Journal of IT, Engineering and Applied Sciences Research (IJIEASR) ISSN: 2319-4413 Volume 2, No. 1, January 2013 i-Xplore International Research Journal Consortium www.irjcjournals.org

Dumitru Erhan, Christian Szegedy, Alexander Toshev, and Dragomir Anguelov(2012), Scalable Object Detection using Deep Neural Networks

Son Lam Phung, A. Bouzerdoum (2007),A Pyramidal Neural Network For Visual Pattern
Recognition. IEEE Transactions on Neural Networks, March 2007, 18(2), 329-343.

Jayanta Kumar Basu1, Debnath Bhattacharyya2, Tai-hoon Kim2 (2010), Use of Artificial Neural Network in Pattern Recognition. International Journal of Software Engineering and Its Applications Vol. 4, No. 2.

Kunihiko fukushima(1987), Neocognitron: A Hierarchical Neural Network Capable
of Visual Pattern Recognition.

Hafiz T. Hassan, Muhammad U. Khalid and Kashif Imran(2010) Intelligent object and pattern recognition using ensembles in back propagation neural network. International Journal of Electrical & Computer Sciences IJECS-IJENS Vol:10 No:06

The IISTE is a pioneer in the Open-Access hosting service and academic event management. The aim of the firm is Accelerating Global Knowledge Sharing.

More information about the firm can be found on the homepage:
http://www.iiste.org

CALL FOR JOURNAL PAPERS

There are more than 30 peer-reviewed academic journals hosted under the hosting platform.

Prospective authors of journals can find the submission instruction on the following page: http://www.iiste.org/journals/ All the journals articles are available online to the readers all over the world without financial, legal, or technical barriers other than those inseparable from gaining access to the internet itself. Paper version of the journals is also available upon request of readers and authors.

MORE RESOURCES

Book publication information: http://www.iiste.org/book/

Academic conference: http://www.iiste.org/conference/upcoming-conferences-call-for-paper/

IISTE Knowledge Sharing Partners

EBSCO, Index Copernicus, Ulrich's Periodicals Directory, JournalTOCS, PKP Open Archives Harvester, Bielefeld Academic Search Engine, Elektronische Zeitschriftenbibliothek EZB, Open J-Gate, OCLC WorldCat, Universe Digtial Library , NewJour, Google Scholar