Asian Journal of Research in Computer Science

4(1): 1-9, 2019; Article no.AJRCOS.49293
ISSN: 2581-8260

Improvement of E-learning Based via Learning Management Systems (LMS) Using Artificial Neural Networks

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Authors' contributions

This work was carried out in collaboration among all authors. All authors read and approved the final manuscript.

Article Information

DOI: 10.9734/AJRCOS/2019/v4i130105
Editor(s):
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Complete Peer review History: https://sdiarticle4.com/review-history/49293

Original Research Article

Received 26 June 2019
Accepted 10 September 2019
Published 24 September 2019

ABSTRACT

E-Learning nowadays is one of the learning system which uses the latest technologies in the field of innovative learning, it has been an extension of traditional education. The effectiveness of E-Learning lies in achievement of education and improving the student's performance and its reflection on the demands of students by discovering the weaknesses and strengths of the factors affecting distance learning. In this research we have used the multilayered neural networks

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(feedforward neural network) with an input of five neurons which represent the five criteria (virtual class presence, Discussion during semester, Solving Quiz, Mid-term examination, Assignment), hidden layer has two neurons and the output layers have one neuron. to estimate the performance of the students attending an E-Learning course, feedforward neural network was applied to real data(400 student records (80%) are used for training data and the remaining 100 records (20%) are used as test data, performance = 0.0699), to predict the performance of the students that reflect their real grades.

Keywords: Distance learning; learning management system; artificial neural networks.

1. INTRODUCTION

In the last decade the Internet has become a home of make available resources for research and learning for both teachers and students to share and acquire information [1]. There is a considerable debate on the definition of the term E-Learning according to Dublin [2] tend to reveal the specialization and interest of the researchers. E-Learning as a concept covers a range of applications, learning methods and processes [3]. It is therefore difficult to find a commonly accepted definition for the term E-Learning. According to Oblinger and Dublin [2], there is even no common definition for the term. Also, the European Commission [4] defines, E-Learning as the use of new multimedia technologies and the Internet to increase learning quality by easing access to facilities and services as well as distant exchanges and collaboration. Today, E-Learning is widely used worldwide to desired educational outcomes in different educational conditions [5,6,7].

Algahtani divided E-Learning into two basic types, (i.e. computer-based and the internet based e-learning. There are different types of E-Learning besides, there are also different ways of employing the technique in education [8]. In his evaluation of E-Learning effectiveness and experience in Saudi Arabia, he discovered three distinct models of using E-Learning in education including the “adjunct, blended E-Learning and online”.

2. RELATED WORKS

Ting Fei, et.al.[9] exploring automatic question classification tests which can be used in E-Learning system using ANN. Such tests take the form of multiple-choice as well as fill-in-the-blank and short-answer. Their system results show that the system achieved the performance in terms of F1 value of nearly 78% [2]. Parminder Kaur, Kiranjit Kaur and Gurdeepak Singh introduce a model using ANN to improve the E-Learning environment [10]. They show that the using of neural networks in the E-Learning systems can be made more dynamic by allowing personalization of the learning environment to suit the needs of the learner. Jorge Mota design, development and implementation a model of an adaptive course player that uses Kolb learning styles and neural networks to model learners and dynamically generates [11]. Navigation paths and layout adaptation [12]. His system implements adaptation of individual recommendations and content adaptation based on learning styles, previous learner knowledge, learner’s progress and persistence of their own preferences. Petar Halachev proposed a model for prediction of the outcome indicators of e-Learning, based on Balanced Score Card (BSC) by Neural Networks (NN). He use a numerical experiments on the basis of real data to see the efficiency and applicability of the method [13]. Dekson D.E and Jaichandran. R proposes an online intelligent performance monitoring system to validate knowledge gained by learners based on neural networks when accessing E-Learning contents.

Their objectives are to enhance teaching, learning and assessment practices [14]. Mohamed Sayed and Faris Baker introduced an artificial neural network model is as a type of supervised learning, the type of network input is the parameters of learning and the objectives is to optimized and correct output for that input then, students‟ performance can be efficiently predicted and so the danger of failing in an enrolled e-course should be reduced [15]. Villaverd et al. are present an approach to recognize automatically the learning styles of individual students according to the actions that he or she has performed in an E-Learning environment based upon feed-forward neural networks. Their approach has two advantages an automatic mechanism for style recognition facilitates the gathering of information about learning references, making it imperceptible to students. Second, the proposed algorithm uses the recent history of the system usage so that

systems using this approach can recognize changes in learning styles or some of their dimensions over time [16].

3. ARTIFICIAL NEURAL NETWORKS (ANN)

Artificial Neural Networks (ANN) are composed of simple elements operating in parallel. These elements are inspired by biological nervous systems. As in nature, the connections between elements largely determine the network function. You can train a neural network to perform a particular function by adjusting the values of the connections (weights) between elements [17].

According to Haykin [18], the function of hidden neurons is to intervene between the external input and the network output in some useful manner. Existence of one or more hidden layers enable the network to extract higher-order statistics.

The most important feature of a neural network that is its "learning" capability. Neural network can enhance weights, learn from its environment and improve its performance through learning.

Feedforward neural networks are known as also Multi-layered Network (MLN). These networks are called feedforward because the information only travels forward in the neural network, through the input nodes then through the hidden layers and finally through the output nodes. In Multi-layered Network there are no feedback connections such that the output of the network is fed back into itself. These networks are represented by a combination of many simpler models (sigmoid neurons), see Fig. 1.

A feedforward neural network with information flowing left to right. Feed foward neural networks are primarily used for supervised learning in cases where the data to be learned is neither sequential nor time-dependent. That is, feedforward neural networks compute a function f on fixed size input x such that f(x)≈y for training pairs (x, y).

Multi-layer feed-forward neural network are "fully connected" because every neuron in each layer must be connected to every other neuron in the next forward layer. If some of the synaptic connections were missing, the network would be called as "partially connected".

In Fig. 1 a multi-layer feed-forward neural network with one "hidden layer" is depicted. As opposed to a single-layer network, there is (at least) one layer of "hidden neurons" between the input and output layers.

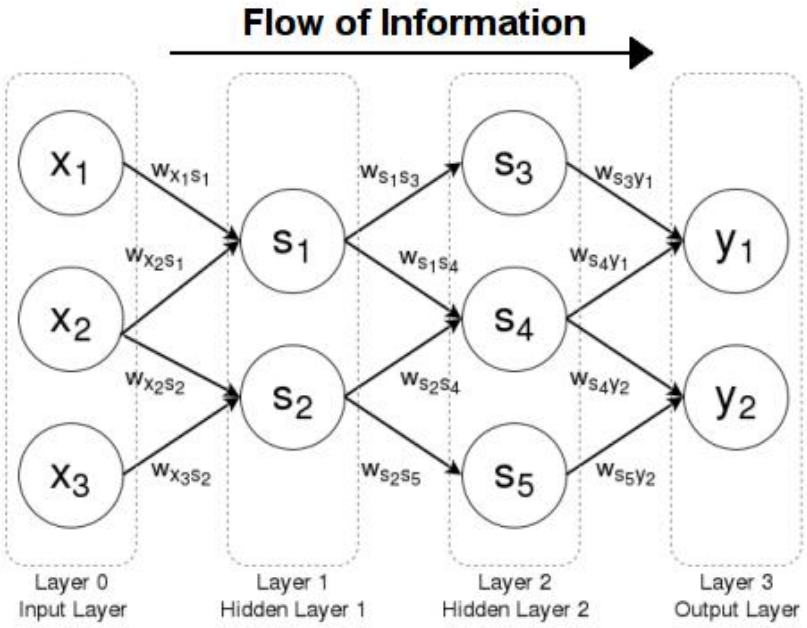

Fig. 1. General FFNN structure

Recently E-Learning researchers combine ANN to enhance the outputs of the E-Learning systems. An elementary neuron with R inputs is shown below in Fig.2. Each input is weighted with an appropriate w. The sum of the weighted inputs and the bias forms the input to the transfer function f. Neurons can use any differentiable transfer function f to generate their output. In our research Feedforward networks have one hidden layers of sigmoid neurons followed by an output layer of linear neurons.

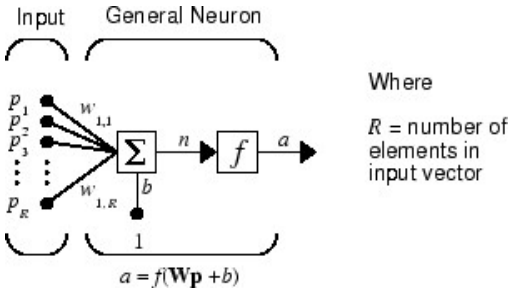

Fig. 2. An elementary neuron with R inputs

In this paper we presented a model using feedforward neural network to enhance the output of E-Learning system. The objectives of the system are to advice students to gain a good degree in their final results.

4. EXPERIMENTS DESIGN

In this paper we conducted an experiment using a data set of a course work educational activities for 500 enrolled students for one semester. We used the evaluation of students through the E-Learning management system. This system has educational activities including virtual lectures through the virtual classrooms. The evaluation of student within the semester is taken from the following:

- Virtual class presence 5 marks.
- Discussion during semester 5 marks.
- Solving Quiz 5 marks.
- The Mid-term examination 20 marks
- Assignment 5 marks.

The sessional marks of all semester education activities are 40 marks. These 40 marks are automatically evaluated by E-Learning management system, the remaining 60 marks is for final examination which will be held after completion of semester i.e. same as traditional examination. The most important thing for student is to physically attend final examination, if he/she will not physical attend final examination then he/she can take advantage for Alternative examination. 400 student records (80%) are used for training data and the remaining 100 records (20%) are used as test data.

Because the data are variable, mixed, non-related, and students' grades are usually positive values, we used normalization to obtain logical and satisfactory results when we prepare and train the network.

So this data is normalize to be between 0 and 1 using the equation 1.

$$x' = \frac{x_i - x_{min}}{x_{max} - x_{min}} \quad (1)$$

The feedforward neural network is a particular type of network which consists of a group of sensory units. These units are observed as

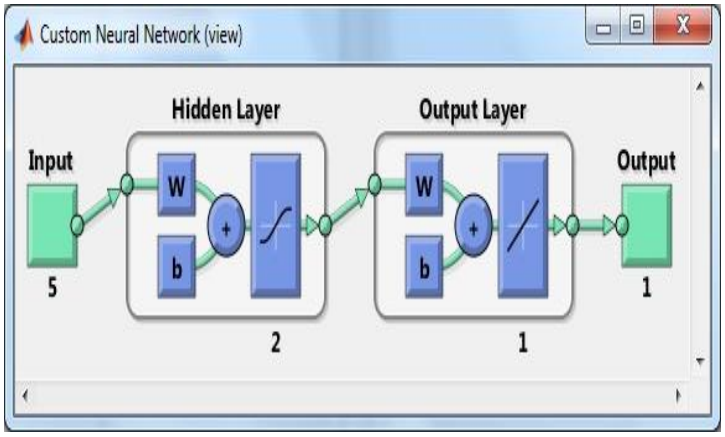

Fig. 3. Feedforward ANN

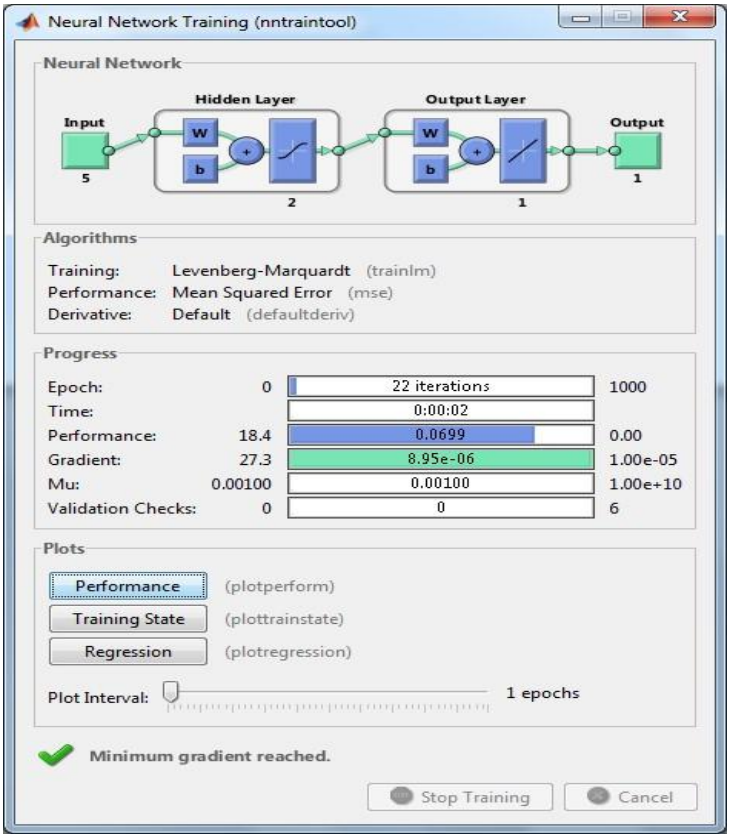

Fig. 4. The training of the feedforward neural network

cascading layers; an input layer, one (or more) intermediate-hidden layers and an output layer of neurons. The neural network is completely connected such that all neurons of each layer are connected to all neurons in the preceding layer. Fig. 3 shows the structure of the feed forward neural network with an input of five neurons which represent the five variables as discussed in data set above, the hidden layer has two neurons and the output layer have one neuron as the performance of the students according to their works through the semester as the results to the output of the above variables.

Fig. 4 shows the training of the feedforward neural network, the network converge at gradient 0.95e-06.

5. RESULTS AND DISCUSSION

Based on concrete data entry, calculation of outputs, improved weights and reduction of the difference between the required limit and actual outputs obtained to produce desirable outputs. where We trained the network on 80% of the data and the network test in 20% of the total data, the error rate was determined for regression at frequency 22, the frequency at MU = 0.001, performance = 0.0699) (Fig. 4).

In Fig. 5, The feedforward neural network continues to decrease the error, until the network reaches the stability stage, when the errors of the mean square stop decreasing, in our research errors stop decreasing with epoch equal to 22.

In Fig. 6, showed the majority of the points mostly fall between −0.13 and +0.13 values. This indicates that the training algorithm has only few outliers and generally of a good prediction outcomes.

In Fig. 7, to verify the artificial neural network estimation, all available data is randomly captured and the graph shows that most of the data gathered around the straight line with little data sloping near zero.

In Fig. 8, the gradient decent calculated by feedforward neural network was not increasing, hence stopped at epoch 22 with value 0.089488.

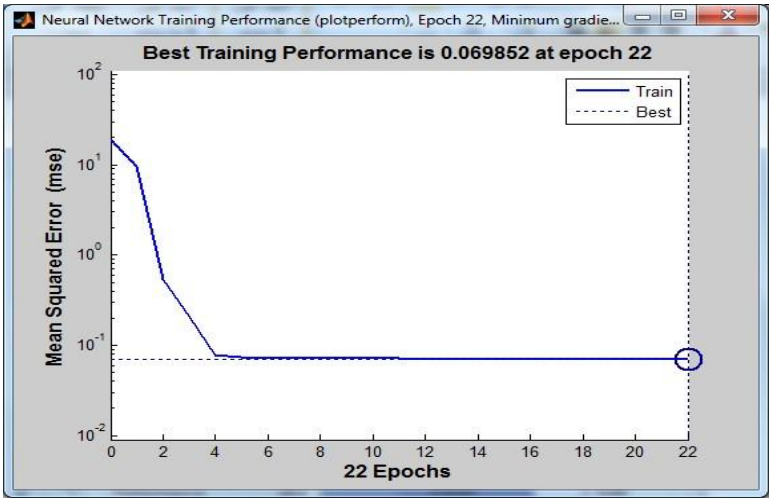

Fig. 5. The best t performance of the training data

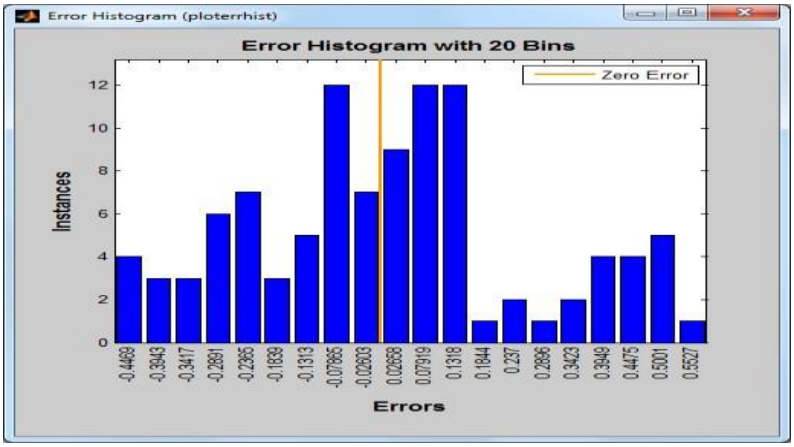

Fig. 6. Plot of the error histogram

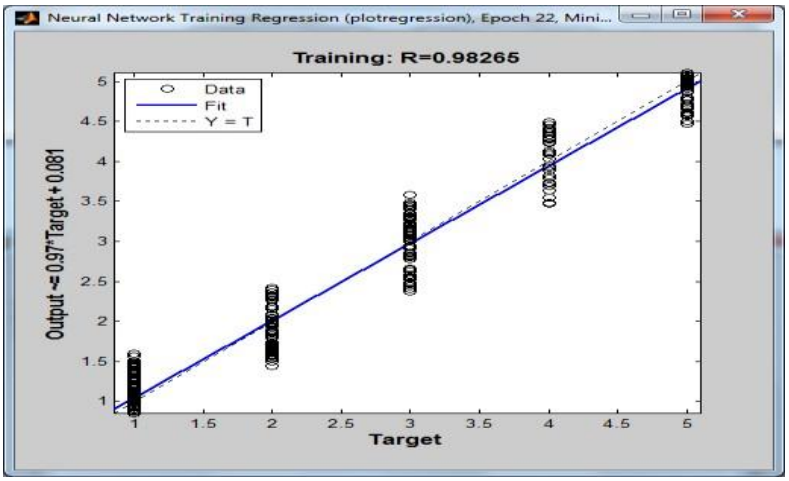

Fig. 7. Plot of the Regression values(R)

The feed forward neural network became ready and trained to perform the desired function to predict the Grade Point Average (GPA) for future students, provided predictors are available.

This table contain five criteria distributed on fie columns (Virtual class presence ,Discussion during semester, Quiz, The Mid-term examination and assignments in rows, as input to Neural Network for per student of E-Learning, since the last column contain the output of the neural network which Evaluate the outcomes .The inputs values are limited to zero and one whereas the value is closer to one, it means that the student get max degree and vice versa when values are limited to zero ,student get min degree ,according to the normalization equation:

$$x' = \frac{x_i - x_{min}}{x_{max} - x_{min}}$$

The last column of this table contains the Neural Network outcomes evaluation, which means that where the value is closer to zero then the estimation is closer to the excellence and vice versa when The higher the values are from zero and closer to 5, the closer to "weak" or “acceptable” evaluation.

We believe that the network according to the values of the criteria entered for the examination has been able to classify students according to their educational attainment and these predictive results are important and help and urge students to improve their educational attainment according to E- learning criteria.

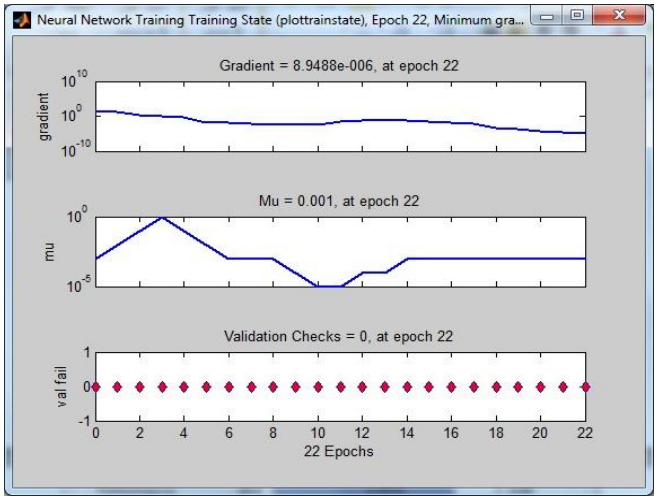

Fig. 8. Plot of the training state

Table 1 . Testing inputs and outputs of NN

Virtual class presence	Discussion	Quiz	Mid-term	Assignment	Grade
1	1	1	1	1	0.5456
0.9	0.9	0.9	0.9	0.9	0.8157
0.8	0.8	0.8	0.8	0.8	1.367
0.7	0.7	0.7	0.7	0.7	2.3928
0.6	0.6	0.6	0.6	0.6	3.7955
0.5	0.5	0.5	0.5	0.5	4.5056
0.4	0.4	0.4	0.4	0.4	4.9894
0.2	0.2	0.2	0.2	0.2	5.1654
0.1	0.1	0.1	0.1	0.1	5.3623
0.0	0.0	0.0	0.0	0.0	5.2441
0.9	0.9	0.9	0.9	0.0	4.7683
0.9	0.9	0.9	0.0	0.0	5.3497
0.9	0.0	0.0	0.9	0.9	2.4979
0.9	0.9	0.9	0.0	0.9	2.4116
0.9	0.9	0.0	0.0	0.9	3.3990
0.9	0.9	0.0	0.9	0.0	4.8489

6. CONCLUSION

Evaluating and predicting the efficiency of E-Learning is important to improve the level of students studying remotely .In this context, this paper provided advice to distance learning students that the coordinators of distance learning programs advise students to ensure periodic follow-up, practical activities, exercises and continuous testing return to the students benefit. This paper is a step towards solving the local problem. Thus improving performance results depending on the various aspects of E-Learning evaluation.

So, it requires further more advance learning algorithms such as deep learning, SVM or hybrid learning algorithms and applied it to real data and to be extended to almost if not all other variables that have not been selected in our research.

7. FUTURE WORK

We will do a comparative study with another intelligent method like Deep Learning or SVM.

With constant advancements in E-Learning technologies higher classification methods like deep learning or support vector machine (SVM) is needed ,since conduct a comparative evaluation with SVM or deep learning can perform better results than feedforward NN to achieve high classification accuracy .

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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