ANN TO IMPLEMENT ADAPTIVE E-LEARNING SYSTEM

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ABSTRACT—Artificial Neural Network (ANN) is very efficient in solving various kinds of problems according to learner’s knowledge level. Adaptive E-Learning system can build through ANN. ANN observes and adapts to learners’ progress during interaction with the learning object (LO) [42]. The neural network activity is done under MATLAB tool box.

Keywords — ANN, MATLAB, AI, LO, E-Learning;

INTRODUCTION

Adaptive education brings knowledge from different sources to the learners. Due to such diversity it requires special teaching and learning approaches. Adaptive e-learning can offer significant advantages over traditional education, e.g., providing organized access to many resources, more flexible and superior quality delivery structures and new learning opportunities. There was an analysis conducted which supported e-learning like different Virtual Learning Environments, machine learning, e-tools and techniques. In that sequence with several recommendations ANN promotes machine learning to create high quality adaptive e-learning education. It is easy to use versus creative freedom, automated programming, extensibility, interoperability and standards. A great deal of research has gone into teaching and learning theories over the years. Although there are a variety of researches, ANN is the most significant. Applying corresponding machine learning to the biggest learning effect of the learners’ knowledge level can be achieved.

1. ARTIFICIAL NEURAL NETWORK

ANN models have particular properties such as the learning, adaptation and cluster data [Michel A., Yen Si Y, 1991]. ANN is rigorously engaged in various fields associated to the classification tasks such as pattern and speech recognition, non-linear systems identification and control. They are able to discover the hidden relations between data. The purpose of this process is to find the suitable set of learning object (LO) related to the set of parameters which can work out from learner’s activities. Problem of adaptive course generation based on learner profiles can be analyzed as a classification dilemma [Idris, Yusof, Saad, 2009]. ANN model’s inspiration has been gained from biological neural system and is built up with an entire interrelation of simple computational elements equivalent to the biological neurons. Each association is characterized by a variable weight that is adjusted throughout the “training stage” as shown in Fig. 1.1.

![Artificial neuron](image)

In ANN model, input neurons in the input layer are related to the learning goal of the course. Hidden layer does all the computation in accordance with the input layer. Subsequently, the output layer determines what knowledge should be presented through every output neuron. In the inception segment, during the training stage manually modification is done which is heuristically initialized by changing the number of hidden neurons. A back-propagation network was used to be trained from the data. The main workhorse of ANN is the back-propagation network which is widely used in the learning environment [Basheer & Hajmeer, 2000]. This network is completely connected, layered and feed-forward neural network (Fig.1.2). The network flows in single direction from the input to the output layer through the hidden layer. To every unit in the subsequent layer, each unit in a layer is linked in the forward direction. Multiple hidden layers may contain in a back-propagation network. For approximate continuous problem functioning, a hidden layer is sufficient [Basheer & Hajmeer, 2000]. Usually, the two hidden layers are required for learning functions with discontinuities [Masters, 1994]. Hence, each layer in MATLAB environment can be trained with various neurons by using one or two hidden layer in the network. The capability of MATLAB tools in writing scripts that help in developing Artificial Neural Network models [ANNM] for the forecast of learner’s knowledge level. It
has a huge library of functions and scripts. The residential scripts use built-in commands and methods for customizing data processing, network architecture, training algorithms and testing performance of the ANN models. MATLAB provides built-in transfer functions which are used in this study; linear (purelin), Hyperbolic Tangent Sigmoid (logsig) and Logistic Sigmoid (tansig). Its predefined tool for pattern recognition (nprttool) is based on a neural network characterized by:

- One hidden layer (the number of the hidden units can be chosen by the user)
- Logistic (logsig) activation functions for both hidden and output units
- Backpropagation algorithm based on a scaled conjugate gradient minimization method

As activation function in hidden layer denote as sigmoid function. For output neurons, first linear activation function and then sigmoid activation function were used. Knowledge of the network is encoded in the weights between units. The activation levels of the units in the output layer determine the output of the whole network (Hamdi, 2007). Such, network can learn the mapping from one data space to another using example, and also has a high generalization capability. Through the ‘Back Propagation’ training of multiple layer perceptron is done by computing the difference between the neural network responses upon input vectors and the desired outputs [Seridi, Sari, Sellami, 2006].

![Fig. 1.2: A multi-layer back-propagation network.](image)

To change in a surrounding environment to adapt synaptic weights, the neural network has a built-in capability. It can be easily retrained to deal with small changes in the operating environment condition by specific neural network trained to operate in a precise environment.

2. ADAPTIVE E-LEARNING USING ARTIFICIAL NEURAL NETWORK

The successful implementation of e-learning systems depend a great deal on whether these systems can provide an adaptive system with an adaptive interface to the learners depending upon various factors like their learning abilities, professional environment, LOs etc.

Many researchers are trying to provide personalized web-based learning mechanisms in a current learning environment (Chen, 2005). Hence, personalized e-learning strategy is being discovered and is need of the hour. Therefore, learners enjoyed better achievement in learning environments that adapted to and supported their personal learning direction (Xu & Wang, 2006). By the use of an ANN, a classifier of learning material as a function of concepts to be learned upon the experiences is build and investigates the use of computational intelligence for adaptive lesson sequencing in a distance learning environment [Hassina, Toufik and Mokhtar, 2006]. Ahmad Baylari and Gh.A. Montazer (2009) suggested a personalized multi-agent e-learning system based on item response theory (IRT) and artificial neural network which presents adaptive tests (based on IRT) and personalized recommendations (based on ANN). These will increase the quality of learning by personalization and interactivity. Personalization appends adaptivity and interactivity to the learning environment and proceeds as an individual trainer which directs the learners in a friendly and personalized training environment. The success rate of implementation of e-learning technology can be vastly improved by the use of neural networks. Using neural networks on the web based environment the registered students can be classified on various factors viz. learning abilities, goal of study etc. and hence be provided suitable integrated environments for study [Parminder, Kiranjit, Gurdeepak, 2012]. ANN supports to recognize the learning styles of individual learner according to the actions or navigations that they have performed on an e-learning application [Kolekar, S.V., 2010]. Neural networks can further be used for evaluation purpose, Furkan (2008) classify examination performances that depends on e-learning environment. Feed-forward neural networks able to present the recognition mechanism in adaptive e-learning environments to help in the detection of students’ learning styles and, thus, conveniently adapt the contents of academic courses that are presented to them [Villaverde, Godoy & Amandi, 2006]. In the e-learning system neural networks are also well suited for emotion recognition in speech [Lin-feng et al., 2007]. ANN are very efficient in solving various kinds of problems. The results study that although neural networks takes much time in training and testing but are more accurate in classification then decision trees [Koushal Kumar, 2012]. Scaled Gradient Conjugate Back propagation (SCG) algorithm is the popular algorithm for developing ANN model. With this algorithm [Abhay, Pranav, 2013] focused on the development of the artificial neural network model for the assessment of human capacity based on the organizational performances.

3. ADAPTIVE E-LEARNING ENVIRONMENT
MATLAB is a numerical computing environment and also a programming language. It allows easy matrix operation, attractive graphs, execution of algorithms, generating user interfaces and interfacing with programs in other environment. MATLAB contains the neural network tools for designing, implementing, visualizing and simulating neural networks. It also provides full hold for many proven network paradigms, over and above GUIs that facilitate the user to design and control neural networks in a very simple way (http://www.mathworks.com/products/neuralnet) [Maitha, Ali and Hassan, 2011]. In this article MATLAB (R2008a) is used for developing ANN and performance functions for calculating the model performance error statistics such as epochs, mean square error (MSE), percent error (%E), confusion matrix and receiver operating characteristic (ROC) curve.

Epochs: The training of the network occurs through the many cycles of LOs presented to the network. These cycles are called epochs or iterations. Epochs are number of LOs consists in the data set. The data set is divided into a learning and validation set. Learning data set is used to train the network in supervised mode and validation data set is used to test the network performance. Maximum number of epochs to be trained in ANN model is 1000.

MSE: MSE is a performance function to measure the distance/similarity of the target and output.

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MSE = \sum_{i=1}^{N} \frac{(t_i - o_i)^2}{N}
\]

Where \(t_i\) is the target and \(o_i\) is the observed output and \(N\) is the number of data set. \(N\) is the number of epochs. MSE is a relative criterion to select the best model, namely the smaller the value the better the model has performed [Makridais, Wheelwright and Hyndman, 1998].

Percent Error (%E): %E indicates the fraction of samples which are misclassified and used to compare the performances of each implemented classifying indicator. After training the network the perfect classification of the network are assessed according to the achieved MSE and %E.

Overfitting: Overfitting or overtraining is one of the problems that would occur in training process. In this system of learning, the network memorizes the training data and its performance in these data will be fast and superior. The new data were presented to the network the problem of overfitting would arise, hence its performance reduces to low. This is due to excessive large number of training cycles used or may be large number of hidden nodes (Basheer & Hajmeer, 2000). Therefore, it is suggested to early stopping or to validation data to stop training, when the errors on these data increase.

**ROC curve:** Fig. 3.1 shows Receiver Operating Characteristic (ROC) Curve for training, validation and testing data. ROC curves are another way in addition to confusion matrices to analyze the performance of classifiers. A ROC curve is a plot with the false positive rate on the X axis and the true positive rate on the Y axis. The point (0, 1) is the perfect classifier because it classifies all accurate classifier and misclassifier correctly. The point (0, 1) represents the false positive rate is 0 (none), and the true positive rate is 1 (all). The point (1, 1) represents to a classifier that predicts every classification to be accurate, while the point (0, 0) represents a classifier that predicts all classifier to be negative. Point (1, 0) is the classifier that is incorrect for all classifications.

![ROC curve for training, validation, testing and for All ROC](image)

Fig. 3.1: ROC curve for training, validation, testing and for All ROC

The diagonal curve will be best for any model.

**Confusion Matrix:** Confusion matrix, which shows the relationship between the outputs of the network and the targets. In Fig. 3.2 all training, validation and testing confusion matrices are shown. Supervised learning is a machine learning technique for creating a function from training data and in artificial intelligence (AI) concept; a confusion matrix is an indicator that is generally used in supervised learning. Each column of the matrix represents the classification of the target class, while each row represents the classification of the output class. The confusion matrix shows the percentages of correct and incorrect classifications. Correct classifications are in green squares on the matrices diagonal and incorrect classifications are in red squares. The lower right blue squares illustrate the overall accuracies. In fact, a confusion matrix contains information about correct and incorrect classification of the predicted classes. Performance of such systems is commonly evaluated using the percentage of data in the matrix.
This Article describes ANN. It also gives information about how an adaptive web based e-learning is enhanced through ANN as machine learning. The different models used in the system helps the learner to provide them with the learning content appropriately. This can increase the learners’ knowledge level.

**BIBLIOGRAPHY**


