



**DATA MINING USING  
ARTIFICIAL NEURAL NETWORK TECHNIQUES**

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**DATA MINING USING  
ARTIFICIAL NEURAL NETWORK TECHNIQUES**

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**BY  
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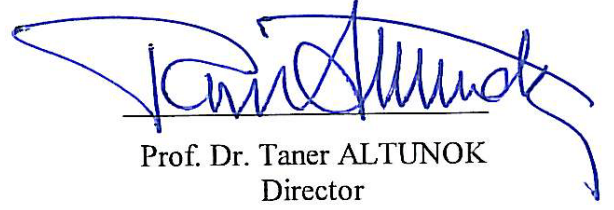
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Submitted by **Nadia DULAIMI**

Approval of the Graduate School of Natural and Applied Sciences, Çankaya University.



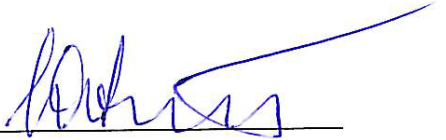
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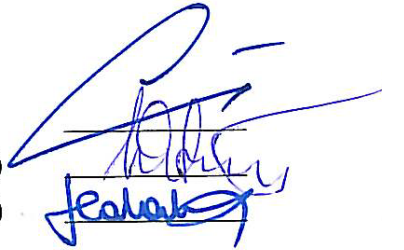
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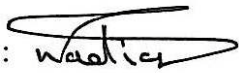
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## **ABSTRACT**

### **DATA MINING USING ARTIFICIAL NEURAL NETWORK TECHNIQUES**

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With the increasing data stored in files and databases, it is important to develop strong tools for analysis data like data mining. The major goal of data mining is to discover knowledge of the data and obtain beneficial information from databases which have ability to assist in decision making. Data mining techniques in educational data set used to assist in the analysis of these data and the discovery of invisible knowledge of the data. The objective of this research is how data mining techniques performed on educational datasets to predicting the likely performance of a candidates students being considered for admission into higher studies master at the university. The study model of ANN trained and developed by exercising data for students admitted to study masters in Kirkuk university (2013-2014). Flexibility and high prediction precision rate are the major benefits of this system .The technique can be well decision tool to help university admission administrators in selecting students that be successful in an master program, depended on cumulative average that influence to admission of a student .With the ANN we discover the knowledge to depicts the students performance in the final exams. This way is proper for selecting qualified the students and forecasting they will succeed in the higher studies. Usually, more number of layers and more neurons in every layer can make improve network with lower error average, therefore the network that is decided for use must have lowest error rate.

**Keywords:** Artificial Neural Networks, Educational Dataset, My SQL Server5.5, Matlab.

## ÖZ

### YAPAY SİNİR AĞI TEKNİKLERİ KULLANILARAK VERİ MADENCİLİĞİ

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Dosya ve veritabanlarında kayıtlı çoğalan verilerle veri analizi yapmak için veri madenciliği gibi sağlam araçların geliştirilmesi önemlidir. Veri madenciliğinin asıl hedefi; verilere ilişkin bilgiyi keşfetmek ve karar verme sürecine yardım edebilecek veri tabanlarından yararlı bilgileri elde etmektir. Eğitimsel datasetlerinde veri madenciliği teknikleri bu verilerin analizine ve bu verilere ilişkin görünmez bilgilerin bulunmasına yardımcı olmak için kullanılmıştır. Bu araştırmanın amacı; eğitimsel datasetlerinde yürütülen veri madenciliği tekniklerinin, öğrenci adaylarının üniversitedeki daha yüksek eğitimlere (master) kabulü için olası performanslarının nasıl tahmin edildiğidir. ANN çalışma modeli Kerkük Üniversitesinde (2013-2014) Master yapmaya kabul edilen öğrencilere ilişkin olarak elde edilen verilerle üzerinde çalışılmış ve geliştirilmiştir. Esneklik ve yüksek tahmin hassasiyet oranı bu sistemin en önemli yararlarıdır. Teknik üniversite kabul idarecilerine bir master programında başarılı olacak öğrencileri seçmede yardımcı olacak bir karar verme aracı olabilir. Öğrencilerin kümülatif ortalamaları kabul şansını etkilemektedir. ANN ile öğrencilerin final sınavlarındaki performansını bilgilerinin gösterdiğini keşfettik. Bu, daha kalifiye öğrencilerin seçimine ilişkin ve daha yüksek eğitimlerinde başarılı olacaklarına dair en doğru yoldur. Genellikle, daha fazla tabaka sayısı ve her tabakada daha fazla nöronların varlığı daha az ortalama hatayla ağ geliştirmeyi sağlayabilir bu nedenle kullanım için karar verilen ağ mutlaka en az hata oranına sahip olmalıdır.

**Anahtar Kelimeler:** Yapay Sinir Ağları, Eğitim Dataset, My SQL Server5.5, Matlab.

## **ACKNOWLEDGEMENTS**

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## **LIST OF ABBREVIATIONS**

DM	Data Mining
KDD	Knowledge Discovery Data mining
ICT	Information and Communication Technology
AI	Artificial Intelligence
NNS	Neural Networks
ANN	Artificial Neural Networks
MLPs	Multi-Layer Perceptrons
BP	Back-Propagation
LM	Levenberg-Marquardt
MSE	Mean Square Error
FB-ANN	Feed Back Artificial Neural Networks
BPNN	Back Propagation Neural Network

## CHAPTER 1

### INTRODUCTION

#### 1.1 Background

In recent years, the data mining (DM) is a rising studies field with significant implementations. DM expands to be a significant element in various fields in our lives as in education, engineering, medical, trade, and other science. The researchers Pratiyush and Manu reviewed knowledge discovery in data mining and various domains of the data gathered perspective, also they explained that The DM is using of a portion of the applications of KDD [1]. The development of knowledge discovery data mining (KDD) and their relational performance are researched by Sumit and Arvind [2].

The generally goal of the DM process is to discover information from large datasets and convert it into comprehensible structure for more use. Information and Communication Technology (ICT) is a change in itself, as well it makes improvements in technology that can deal with the changes of other applications. This would permit the ICT applications to deal with the changing needs, such as those emerging out vitally changing of the course requirements for university acceptance. Two Crows C. summarized the aim of his book ( Introduction to DM and KD ) that the good choice of products data mining means finding a perfect tool capacity [3], which take out information from a large amount of data has become widely used in the fields of education. Grown application of Artificial Intelligence (AI) in education, supported through the fact that it permits us to find new knowledge, attractive and useful on students. DM can supply the answers to other questions abstract Such as "discover the students who might succeed the exams.

The higher education finally excited and began to resort to the approaches and methods of DM educational, which proved to be crucial when dealing with complex issues of academic and vitality. Data mining (DM) is a method of detection exciting, beneficial patterns, and relations in huge amounts of data. This field such as neural networks (NNs), machine learning, and the tools of statistics with database administration for the analysis of huge digital sets identified as the data sets. Overall artificial neural network called a neural network, ANN is an arithmetic pattern that is suggested by functional feature and the biological neural networks structure.

The ANN as a way of AI has become very significant in making predictions and improved the prediction by selection successful. The researcher Smita has proved that ANN offer creates it a strong and exciting tool to be applied in the DM domain [4]. Student efficiency prediction is necessary in educational organizations. When admission officers accepting applications, accurate predictions help them to distinguish between suitable and unsuitable candidates for the master's program and identify and identify candidates who are likely to achieve good results at the university. The failure to achieve an accurate admittance decision may result in an inappropriate student being accepted to the university. Thus, reflected in educational institutions benefit in the field of research and training, and the quality of the accepted candidates affects the quality of institutions. In addition, the results that have been obtained from the prediction of academic efficiency can also be used to predict students, and education that will enable managers to provide them with additional support resources such as help and lessons on demand. The results of prediction can also be utilized through lecturers to identify the most suitable teaching actions for each group of students and supply them with further assistance tailored to their needs. Correct prediction of student attainment is one way to enhance the quality level and supply better educational services. Thus, developing a proper prediction tool is especially significant for educational organizations.

The algorithms of training cooperates a significant part in improving the quality of neural network. Use the professional training algorithm for building a NN that exactly predicts the effectiveness of students. When the neural network restructuring for a particular application, it must be trained before they are used to classify the test data.

The goal of the training stage is to reduce the cost function characterized as the amount of squared error between the actual and goal outputs, or the average squared error by changing the weights and biases. The training stage may include of some epochs. Training algorithm acceptable and successful has constantly been the defiance topic. Accepted the way used in the training stage is (BP) learning.

ANNs be capable of be used to classify the correct course for the students at university, in that order, among the options of their choice. It is expected that stimulates the parties troubled to regard as the potentials to get benefit of and access to methods of enrollment and use of AI in the choice process. The most common problem in information processing is the process of partitioning the data. Multilayer feed-forward NNs has adopted in some areas due to planned and excellent career such as quality control, forecasting etc. Possibility significance to estimate the performance of students to adopt along with the promise of multilayer feed-forward and backward neural networks behavior also works led us to investigate the Artificial Neural Networks computational tool to approximate the level of the students in Education. In the past few years, many business been successfully applied in many areas of modern higher education, but so far there is no general statistical methodologies used to estimate the level of the students. The registration department in universities typically regulates a set of rules in order to accept new students in the higher studies. These rules are set to select applicants who have the abilities and skills to pursue and succeed in their academic career in a particular field of studies. The admission of the college makes certain that qualifications and other essentials of the individual students complete the requirements of the college admission according to its rules and conditions and arrange acceptance tests that result in accepting, or rejecting applicants. It has been observed during the years that the decisions depend on the results of these acceptance tests that is containing additional personal interview and are not sufficient.

The ANNs techniques can play a role in this process and intelligent tool that can assist the decision makers. Educational institutions believe a diversity factors as building admission decisions. Some of the evaluation criteria normally used include the following: grade average, admissions test score, a personal interview and others. The

researchers expanded some mathematical models (for example, to differentiate analysis, multiple regression, and regression imperceptible) to predict the success of the candidates in the master's program. Jothikumar Sivabalan and concluded that the data mining and neural network model can be an effective approach dramatically evolve ways to extract data [5]. The kind of ANN is feed-forward which is one of the mainly convenient forms of ANN to predict and calculate approximately. Using the artificial neural network method in studies is growing. This article is an attempt to build different neural networks by learning algorithms based on goal average prediction using factors in the data. Create the conditions to evaluate the algorithms learning effectiveness after determining the effectiveness of each network. ANNs of the feed forward type, in general called multilayer perceptrons applied in these areas because it is an accurate scheme functional (Can be formulated these problems as to find a good map of the input and output). Given the potential benefit to predict the results of the student graduation along with capable of multilayer-perceptrons activities also classifiers led us to examine the Artificial Neural Networks as a tool to predict the rate of student. This research presents the development, training, and testing of such a network. The results of these predictive models can help the coach to determine whether or not there is a need for educational intervention. For example, the instructor can determine how well, or how poorly, students may perform developing predictive models. Diversity techniques, such as regression and neural networks, have been employed in constructing predictive models. One of the most widely used approach to constructing predictive models, easy to recognize and gives a clear equations.

Neural networks have able to fit every purpose, relationship among inputs and output. Universities began to use the data mining and analysis for predictive data to determine diversity measures of performance. To design the system Feedback rating is based on the data by executing predictive analysis and analysis academic through time series. In this work, the technique used in this research is artificial neural network in data mining by using Matlab software for simulations, and implemented dataset using my Sql server 5.5, PHP. We suggest application in ANN to predict the case of a student in the final exams. Our goal is to identify the best training algorithm for constructing an accurate model for prediction. We have also estimated the classification precision of our



neural network approach. Furthermore, we have introduced NN classifier in a simple to utilize software tool for predicting student performance so as to make the job easier for teachers to recognize weak students as a result of learning troubles in a timely manner and exercised the average grades of students which is inputs and outputs of the acceptance of results. Artificial neural networks were used to forecast the level of the student that have a significant impact on the university to accept a candidate at the Graduate. The above studies exposed the big achievement of NNs to expect student performance. We propose an approach depend on the multilayer feed-forward network. The majority benefit methods in data mining is classification, must estimate activity of various classification algorithms while calculation in a diversity datasets.

Farha, Mirza, and Reena executed these algorithms on unlike dataset to increase performance and to obtain algorithm efficiency through executing techniques of attribute collection, prediction, and data preprocessing. We have discussed with diversity algorithms in classification and various DM implementations [6], and the majority used DM techniques are NNs.

Mainly of the DM algorithms require to be constructed before they are applied. Users have to give suitable results for the parameters in advance so as to find good values, as a result the user must possess a certain amount of expertise in order to obtain the correct settings various methods have been created and design for DM and applying the greatest technique for exacting state is a job of its individual. A diversity kinds models expanded, including NNs. The major focus is to student Average. NNs used to forecast the student's and total Average supported student performance. The levenberg-marquardt Bp can be applied to get faster the process of learning. The factors used for calculating performance of a diversity models are mean square error.

## **1.2 Problem Statement**

In the world, the rise of information has led to the growth of databases. Volumes of data increase year after year, difficult and not easy to interpret the traditional manual methods of data analysis. These cannot analyze the contents of data to focus on important knowledge. This leads to require for new tools and techniques with the ability to help in analyzing the mountains of data smartly with undiscovered knowledge. DM is a process which involves application of many algorithms for extraction of knowledge from big databases. Another problem, detect reduced level of graduates of some Universities may be because weakness in the System of Admission Examination of the University. Today, the admissions process in graduate studies in the universities is very critical. There are many problems at the time of admission in universities because many students apply for studies but seats are restricted. A great challenge to the administration of higher education is a predicting the efficiency of a student.

## **1.3 Research Objective**

The aim of this study is analysis techniques of DM on educational dataset to find invisible beneficial information on the data and discover the hidden knowledge. Data mining that handle challenges. This is useful for predicting the students that are interested to take admission student for the registration in higher studies, this is also useful to select good students for master studies and find candidates who would likely do fine at the university is the major aim of the admission system. The students candidates that are accepted into any university influence the level of the university, and impact on the development of the country itself, as these candidates eventually are Playing a key role in all sectors of the affairs of the country.

## 1.4 Literature Review

The potential use of NNs as a tool for predicting student performance has been increasing in recent years. Large research processed Details classification data entered through the neural network designed for the structural analysis of output. There are several research and strong evidence of this in the literature in the field of learner models that can precisely predict the student performance:

(Budi Rahmani and Hugo Aprilianto) [7]. Depended on testing executed on 166 data, the ANNs that have been built were able to calculate time grouping of student graduation with up to 99.9% accuracy which indicates that among the target and output consequence is equal. Existing data presents correct results in making a calculation reached 99.9% or all of its predictions are correct.

(Sankarasubramanian, Bharathwajan, Rathinakumar and Balakrishnan) [8]. Conclude that the manual execution of the system of admission is worst compared to back propagation of ANNs performance. It is more accurate, best suited, has high processing speed and less cost efficient method of student admission system implementation.

(Oladokun, Charles, and Adebajo) [9]. Indicate the ANNs for improving efficiency of admission system at university. The valuation of test data Presents that the model of Artificial Neural Network is fit to suitably calculate the performance above 70% of probable students.

(Priti and Maitrei) [10]. Using ANNs for treating issue that join two different application scopes of Forecasting and Classification and show the wanted output.

(Franklin, Fullgence) [11]. Applications of ANN adds the explained how trained ANNs can be used opportunity for the applicants of high quality to gain admission to courses for which they are eligible.

(Monica and Fred) [12]. Obtained that (19) researches (86%) generates the results complimentary to forecasting and prediction during NNs. In individuals papers neural networks exceeded choice methods.

(Naik, Srinivasan, and Ragothaman) [13]. Indicates that ANNs model is a beneficial tool in calculating MBA student efficiency and works the arithmetical models.

(Sumit and Arvind) [14]. Show efficiency the ways of data mining that specify efficient getting better tools for effectiveness of students by comparative analysis about different of DM ways.

The remains of this thesis ordered as follows. In chapter 2, we briefly identify the neural network architecture and introduce the ANNs techniques which used in this research, and in chapter 3, brief we present the multilayer perceptron model (MLP) and describe the back propagation algorithm our study. Chapter 4 is dedicated to including simulation and describing the process of neural network training, while chapter 5 reports the experimental results of the case study. At last, chapter 6 presents our conclusion and our proposals for future research.

## CHAPTER 2

### ARTIFICIAL NEURAL NETWORKS

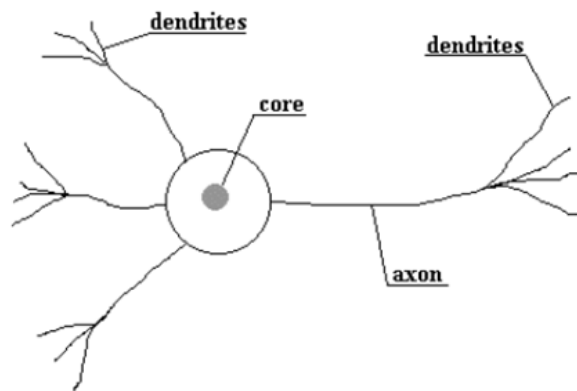
#### 2.1 Introduction

ANNs are a branch of AI, which will offer the exact and competent results. Now NNs are extremely spread with DM users, mainly in education research, business and other area, therefore Prashanth, and Yakhoob have verified DM effectiveness during NNs predictive influence during evaluation with other statistical methods [15]. The expression ‘artificial’ means that NNs are executed in computer that is competent to hold the huge number of essential computations through the process of learning. Sareeta and Maya identified several tools available to DM with ANNs by understand the more widespread model in DM which involve classification, KD, clustering, and etc. [16]. Raja, Srinivasa, and Phanindra also researched about DM using ANNs via general idea of ANNs and question their situation as a favored tool by DM users [17]. ANN has two kinds of essential elements, neuron and link. A neuron is a processing part and a link is utilized to join one neuron with other. Each link has a weight connected with it, and motivated by the brain structure, every unit in planed to imitative its biological matching part, the neuron. Each one admits a weighted put of inputs and replies with an output. El-Midany, El-Baz, and abdelwahed are studied for enhance features of products manufacturer. Outcome have been showed during explained example and viewed that the suggested method is proficient through using ANNs model [18], and The researchers ( Marie, Chady, and Walid ) are considered that the modify of most important matters in education solve test is treated by using DM technologies [19]. ANNs is constructed on a number of uncomplicated processing components, artificial neural network be like the biological neuron in gaining knowledge via learning from examples and depot these information’s among neuron link powers (weights).

Each one neuron gets motivation from various neurons, data processing, and generates an output. All neural units work similar to uncomplicated processor and their manipulating becomes the brain's capabilities conceivable. More researchers for ANN, Apoorvi studied on ANNs for a network by means of easy and high activity [20]. ANN contains of many units ordered in a layered, the first is input layer (A buffer that presents data to the network), and the last is output layer, and the middle are hidden layers. It is not a neural calculating layer for the reason that it hasn't activation functions and weights. Therefore the ANN classified in to single layers (input and output) and multi layers (input, output, and hidden). Researcher Animesh used method of Artificial Neural Networks to huge data [21]. ANNs are trained to do a specific purpose by altering weights among fundamentals. A couple of real input and requested output is needed to train the ANNs. NNs are trained to run special functions in a diversity areas, containing sample recognition, classification, and detection gain. ANN are very often applied in many areas of toxicology for the solving of complex , Vlastimil, Daniel, and Kamil planed by involvement them to present the essential information concerning idea of NNs [22]. ANN carried out classification apparently and proficiently for the reason that its methods of learning and design of structural. Training network is accomplished till network outputs convince the goal desired or till network arrived to desired activity as specified by some error level (Various between output and the target requested of network). Regularly this fault is creates as mean square error (MSE). The weights on connects above which it extends multiplied by activation arriving into a neuron from another neurons, and after that is accumulated both with another arriving activations. NNs in which activations widen just in a forward path from the input layer during hidden layers to output layer is called as a multilayer feed-forward network. For a given set of data, a multi-layer feed-forward network can give a good non-linear relationship. Chady, Marie, and Walid concerned a novel hybrid technique relied on NNs and Clustering committed to students following their education [23]. As well as researchers Bhfindra and Bobndra used neural network and SVM method to evaluate the program and expected to improve software [24]. Additional, Oludele and Olawale proved that the Programs might expand which need feed-back from the client so as to be efficient [25].

## 2.2 The Neuron

A neuron is composed of a cell body, a nucleus, many of the dendrite connects which supplied links of input from another during an axon trunk and synapses which holds progress of output to other units during synapses and Peripheral connects. The links among the neurons adjust. The structure of connection is usually admitted that the energy of learning of the brain person depends on this adaptation. As illustrated in Figure 1:



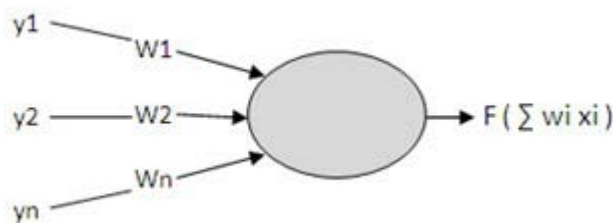
**Figure 1:** Neurons in the human brain model

A neuron is the building block of a neural network that consists of input links, an input function, an activation function, output, and output links to other neurons. Each neuron of one layer is connected to each and every neuron of the next layer. Sunil and Sanjeev obviously explain that the NNs application for model recognition and the number of neuron in the input and output layers wholly based on the arithmetical appearance of system [26].

The links of input supply activation to the neuron from other neurons. Every input link is allocated a weight which established together the signal and the activation potency of connection. The manipulate data of output layer gets from hidden layer and creates output. Saeed and Zabihollah contrast among ANNs regarding as useful features in Educational Learning and Progress during the training process network, weights and

several constant values are accumulated to neurons modify always so as to achieve smallest amount error that means RMS is decreased to least. In addition, move functions are utilized to transmit output of each layer to the upcoming layers [27].

The powerful force of activation the further possible it will be for the alternative to be connected to for more processing. Activation function is planed so that it correspond two conditions. Initially, the neuron ought to be effective with output close to one when the right inputs presented to it, and ineffective with output nearly zero when the wrong inputs are presented. Also, the activation function requires to be of nonlinear, to save the full NN as of becoming uncomplicated linear function. Sigmoid and threshold are two probable alternatives of activation functions. Sigmoid function is functional for a weight learning algorithm. Figure 2 appears neurons. This neuron includes several inputs and a single output. Every input is changed via a weight, which multiplies with the input value. A neuron has  $N$  inputs ( $y_1, \dots, y_n$ ). The inputs are all gives a weight  $W$  ( $w_1, \dots, w_n$ ). Calculated sum of a weighted for all neuron "i", and after that the sum of weighted of its whole input links, which are subsequently exercises in the activation function so as to gain its output.



**Figure 2:** Illustration neurons weight, input, output, and activation function



### **2.3 Artificial Neural Networks Architecture**

NN structural design is obtained by its topological construction and via layers number, weighted associations among units, and nodes number in every layer. Topology of NN is described through nodes and their links. XIN evaluates diverse groupings involving Evolution algorithms and ANNs. It is shown that appreciably enhanced AI systems depending on ANNs [28].

For a given problem the purpose of network architecture is one of the mainly essential steps in evolution a model. Beneficial methods begin with a few units number in network, which is regularly below parameterized, after that progress increment the number of neurons through training till the activity of the network arrive at an acceptable level. Nelson makes an overview linked to several of the mainly pervasive NNs models in apply at present for DM functions, the mining of the secreted knowledge and the DM programs features are checked [29].

The NNs topology can be obtained through fixing number of hidden neurons and via choosing number of connection weights to every node. The adjacent Characteristics of minor and bigger networks should as well be regarded as when choosing the network. Minor networks needs smaller amount storage and have high speed of processing through testing and training, yet the error diagram more difficult and such networks occasionally have more limited minimum. Saini and Nidhi researchers shows from the conduct experiment that the model better conventional backpropagation NNs in addition to arithmetical models, it is moreover detected to be a valuable tool in predicting the students performance joining to every effluence [30].

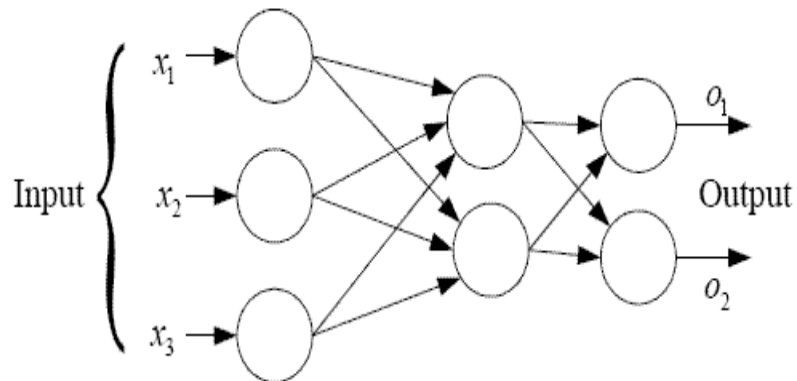
Bigger networks Inclined to learn rapidly terms of a number of training sequences needed and have an improved capability to obviate limited minimum in the error spread, but they need a huge number of training examples so as to accomplish superior majority proficiency. In this research, some numbers of hidden nodes been discovered through the training of both feed-forward and recurrent-networks. Each design performance varied equipped while the expansion and reduce the hidden nodes.

NNs are not just various in their processes of learning however in addition various in their topology or construct. The network classified architectures into the subsequent modules:

### 2.3.1 Feed-forward ANNs

Permit signals to move from input to output through one way just. Sagar, Venkata, and Manoj discussed extremely significant matter of NN to be perfect correction of connection weights in resembling be for learning designed over feed-forward structural , also obtained that the existing technique is very quick [31].

There is no circle, that the every layer output not influences so as to same layer. Feed-forward ANNs resembling be direct forward-networks that relate inputs with outputs. The feed-forward-networks, which are connected all the units in a single layer with units in to next layer. They are widely exercised in pattern-recognition. Illustrate feed-forward-ANNs in a figure 3.

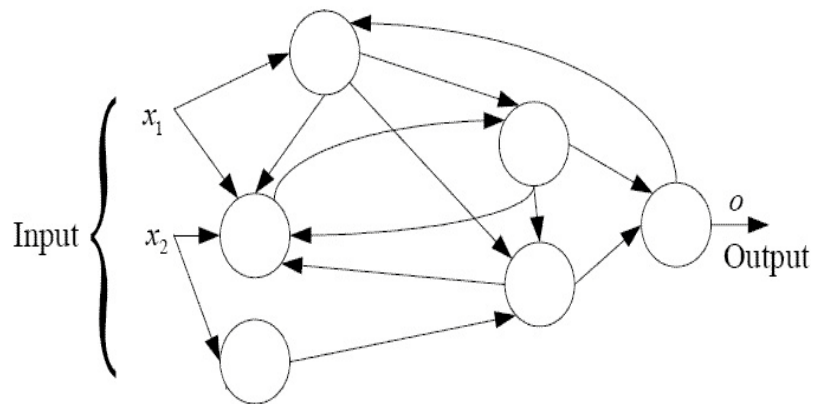


**Figure 3:** Feed forward ANNs

### 2.3.2 Feedback ANNs

FB-ANN can have signals travelling in both directions by introducing loops in the network. Feedback networks are very powerful and can get extremely complicated. Mujeed concluded in your research that the NNs applied to explain more difficult and non linear troubles, and he gave a summarized about feedback network and other artificial neural networks models [32].

FB- neural networks are developed efficiently. Their situation is varying always till they get to stability point. They stay at the stability point till the modifications input and a new stability requires to be obtained. Sonam and Rakesh modified obtainable algorithm learning Back-propagation through modify the force factor and the rate of learning [33]. The architectures of feedback are moreover indicated to as reactive, even though the final phrase is frequently used to Significance feedback connections in only one layer, below Feedback ANNs in a figure 4.



**Figure 4:** Feedback ANNs

## 2.4 Development of ANN Model

The construction of ANNs is declared by the selected of the number in the input, hidden, and output layers. All data set has its own specific structure, and consequently finds the private ANN structure. The neurons number included in the input layer is equivalent to the features number in the data. The neurons number in output layer is the same to the output variables number. In this study, the data set includes (8) input and one output. Therefore, the neurons numbers in the input and output layers are eight and one, consecutive. The three layer feed-forward NNs is utilized in this work as it can be used to estimate every continuous function. As regards the hidden neurons number, an optimal size of hidden layer selection has frequently been studied. However a strict universal technique has not been obtained.

In this research, the selection was made during broad simulation with various selects of the hidden nodes number. We found the performance of NN involved, and the hidden nodes number greatest allocated to display the results supply performance, the best neurons number in the hidden layer was obtained via those number. Initials with at least one and then increased in steps by adding one neuron at a time. Therefore, different architectures of network were tested and training to reach the best hidden neurons number.

The reason of data training is to decrease the errors, which are the distinction among predicted and real values, till the ANNs study the training of data. Several algorithms containing gradient descent with momentum, scaled conjugate gradient, and Levenberg Marquardt, these algorithms are presented for training NNs. It is hard to identify which algorithm is the mainly suitable for a specified trouble as problem type. The data and the architecture of network can influence the activity algorithm of training. The performance of some generally used training algorithms was estimated. Lastly, the Levenberg Marquardt algorithm was selected as it provided enhanced performance from the others.

## 2.5 Learning Algorithms in ANNs

One of the mainly significant characteristics of ANNs is their capability to learn. Learning is a procedure by which the free parameter of a neural network. Even though basic, ANNs can model this learning process by altering the weighted of connections establish among neurons in network. Wagarachchi and Karunananda Has proved experiential outcomes of their research that the adjustment algorithm decreased of network size with no performance degeneration and the network performance based on a number of parameters for example the rate of learning and connections weights [34]. Researcher Sonali offers summary of ANN, functioning and training NNs as well give details NNs advantages, NNs is organized for a detailed application during process of learning [35]. This an effective simulates the reinforcement and impairment of the interlaced links obtained in our brains.

This reinforcement and impairment of the connections is what permits the network to learn. Akshay, Babita and Deepika focused to feed forward networks learning networks and computational learning theory appears relevant training classifiers on a limited amount of data [36]. We must reminder that understand of how precisely the brain performs this is stay extremely primal, though we do stay have a fundamental comprehend of the process. It is thought that through the learning process the brains NNs is modified, growing or lessening the power of its synaptic connections based on their activity. Further appropriate information will have powerful synaptic connections and less significant information will regularly have its synaptic connections weakness, making it most difficult to recall. Learning algorithms are very helpful as it comes to confirmed problems that also can't be virtually written via programmer or be able to done additional proficiently through learning algorithm.

There are several various algorithms that have able to used through training ANNs, everyone with their own cons and pros. The learning process within ANNs is outcome of changing the network's weights, with several kind of learning algorithm. The goal is to obtain a set of weight matrix which while functional to the network must hoped map input to a accurate output.

Neural networks can be classified by the learning algorithm, hence there are two methods applied learning methods to training NNs based on how synapses are adjustment with knowledge: ANN learning models can be classified as unsupervised and supervised. Sathya and Annamma considered the two algorithms of learning that is supervised and unsupervised and explored its characteristics [37].

The two major methods of the learning and neural networks architecture as shown below:

### **2.5.1 Unsupervised learning**

In this model the NNs is only specified a set of inputs and it's the NNs responsibility to find some kind of pattern within the inputs provided without any external aid. This type of learning model is frequently used in DM and is also used by many recommendation algorithms due to their ability to predict a user's. Unsupervised DM is a descriptive approach. Chady El Moucary try at comparing the aforesaid matters with the performance of engineering students then a predictive model is offered and developed so as to give managers with NNs by used Unsupervised learning because Unsupervised DM is a descriptive method [38].

Unsupervised-learning applied with no exterior teacher and is depended on mere local information. It is also indicated to as personality organization, in the sensation that it self-categorizes data accessible to the network and obtains their growing combined characteristic. Examples of unsupervised-learning are competitively learning. Unsupervised training is while the network has to practice data with no outside help. Rather the networks job is to characterize the inputs in another proficient way.

### **2.5.2 Supervised learning**

ANNs is understood to learn supervised, if the requested output (target) for the network is previously identified and supplied with the input through network training. Supervised learning includes an outer teacher, in order that all output is notified what it wanted reply to input must be. By supplying the NNs with together an input and output couple it is probable to compute an error depended on its requested output and actual output. While the inputs are practiced to the system, the outputs created are compared with the requested output. It be capable of utilized that error to make corrections network through adjusting weights. Mohammed Indian in your thesis examined the use of ANNs to resolve the troubles of predicting and learn of digital human model, he has explained that he should use a supervised learning process in his study. Thus, the input and output must be determined to do fit in this important target [39].

A supervised-learning is utilized in regression and classification troubles. Classification represent Supervised-learning in which data be able to specific by predefined technique. Chitranjanjit, Pooja, and Meenu proved in their research that various NNs are clarify assist data classification and assist create learning supervised and unsupervised and approximates the application of neural network in the data mining (DM) and proved that Algorithms supervised proficient and successful performance as a outcome of the character of personality-adjusting [40]. Through the process of learning universal information possibly will be needed. Models of supervised learning contain fault corrected learning. A significant matter related to supervised learning is error converge issue, that is the reducing of error among the requested and calculated values. The goal is to obtain several of weights which reduced the error. The widespread learning method is the least mean square. Supervised learning employ a teacher supplying the requested output with the input in the network. For illustration, while learning to identify different musical tools a teacher would tell the tool playing in order that the NNs be capable of evaluate its answer to the exact one. Even though frequently utilized in artificial neural networks (ANNs), the learning applied in supervised learning are usually regarded as to be unrealistically and improbable to get in biological brains. In this thesis, the type of learning will be based on supervised learning.

## 2.6 Types of ANNs

Artificial neural networks have various kinds of ANNs topological that are suitable for explained diverse categories of troubles. All ANN is a computation model of a biological NNs model. The kinds of ANNs as described below:

- ✚ Multilayer Perceptrons
- ✚ Hopfield
- ✚ Single Layer Perceptrons
- ✚ Self Organization
- ✚ Support Vector Machines
- ✚ Modular Networks
- ✚ Bayesian
- ✚ Hidden Markov
- ✚ Boltzmann Machines
- ✚ Radial-Basis Function
- ✚ Probabilistic Graphical

In this study, a multilayer-perceptron (MLP) was applied. MLP is most commonly learning algorithms utilized for model of ANNs. This kind of neural networks (NNs) is a supervised as it needs a requested output so as to learn. The aim of this kind of NNs is to design a model that properly plans the input to the output. MLP is a robust and simple to implement, furthermore precision of MLP has comparatively higher than another models, therefore MLP applied with the aim of training and estimating the dataset in the network.



## CHAPTER 3

### MULTILAYER MODEL AND BACKPROPAGATION ALGORITHM

#### 3.1 Multilayer Perceptron Model

Multilayer Perceptron network, in addition identified as multilayer feed forward NNs. MLP employ input data onto proper output it is a supervised network and it want a requested output sequentially to learn. Frauke, Günther and Stefan offered a short introduction to multi layer perceptrons. It established the package neural networks (NNs) that be capable of practical as soon as modeling functional associations between variables and reply variables [41].

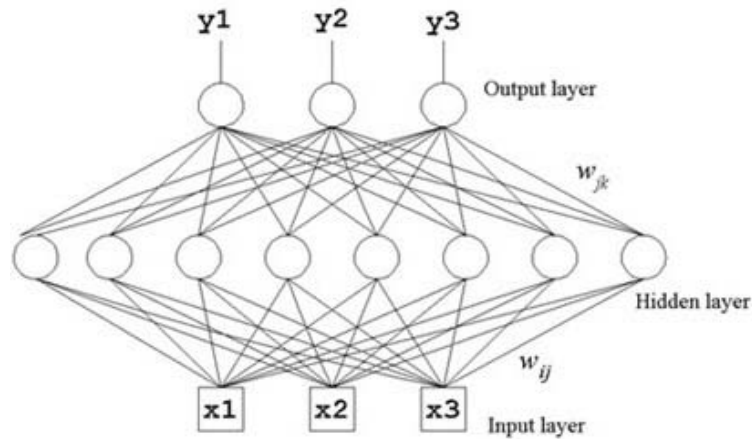
Multilayer Perceptron was inventing, however remains we want a training scheme which might be quicker. The researcher Brijesh planned schemes for rapid training of MLP, the investigational outcomes containing recognition accuracy and training times are specified. In general, the method accomplishes training process is more rapidly than other techniques and he conclude that our scheme ought to be helpful for various actual world troubles [42]. Multilayer Perceptron operates a supervised learning scheme named back propagation for networks training. MLP is alteration of the linear perceptron and be able to decided data that are not linearly independent. MLP is mainly appropriate in support of estimating a classification function. Ajay and Saurabh use various algorithm of classification, current projected model depended on classification method to discover an improved assessment [43]. The majority NNs applications occupy MLPs. Gaurang, Amit, Devyani and Kosta talked about behavioral analysis of various hidden neurons number and various hidden layers number. Multi-layer perceptron are discussed to explain various troubles NNs ought to be trained to execute acceptable classification [44]. The MLP is capable of predict the outputs of diverse processes with high correctness.

### 3.1.1 Multilayer network structure

An MLP includes multiple layers of neurons in a directed scheme. Division of a dataset in classes is a widespread difficulty in processing of information, the researcher Stamos obtained MLP was practiced in these field since they are very good functional planners, these troubles may be created when obtaining a excellent input-output plan) and examination of ANN since a tool for student prediction rates. This object current the expansion and training of network [45]. The network has evolved into three layers, input, output, and hidden layers. With every layer entirely associated to the next. With the exception of input units, every node is a neuron with activation function. MLPs architecture contains of one or more hidden layers among input and output neurons is named multilayer network. The input nodes go values to the first hidden layer, its neurons to the second and continue even generating outputs. Every node is linked to everyone nodes of next layer. For example the network with a layer of input, and one hidden layer and output layer is a two-layer network. Network with two hidden layers mean it's a three layer network, and continue. Their present output based mere on the present input.

MLP trains utilizing back-propagation. While utilizing or examine a trained network, the values of input put the elements values in the 1st hidden layer, which effecting the next layer, and continue till it puts values for the elements of output layer. In MLPs at first weights of the preceding layers will be approved. MLP can be executed via only giving values of link weights. The researcher Shih and Yih were studies about limits on the hidden nodes number in MLPs and studies several basic matters concerning the potential of MLPs with one hidden layer [46]. A good reason for this is that the input layer is utilized just as input control and be able to low-cost.

In the figure 5 illustrates the two layers Multilayer neural network structure:



**Figure 5:** Multilayer network structure

K: Output layer indexed by k

J: Hidden layer indexed by j

I: Input layer indexed by i

$\sigma$  : The function of sigmoid activation

The function below utilized for 2 layers of MLP:

$$f(x) = \sigma( w_{jk} \sigma( w_{ij} x_i + w_{0j} ) + w_{0k} )$$

The input is represented by x. The weights linking the input and the hidden symbolized by  $w_{ij}$  are. And the weights linking output with the hidden  $w_{jk}$  are. These are hidden neurons that allow the MLP network to learn difficult jobs via mining increasingly extra significant information from the input illustrations. MLP has greatly linked connection as each input is linked to everyone neurons in the 1st hidden layer. Every node in hidden layers is linked to all neurons in next layer, and continuous. The input, at first these are the input models, spread during NNs in a forward path on a layer via layer source, the input spread during hidden nodes and processed via their activation functions come out as outputs, also the errors on output units are spread backward during the network in order that every neuron proceeds its error back to the units in the preceding hidden layer.

### 3.1.2 Training in multilayer perceptron (MLP)

The multilayer perceptron and various other NNs train utilizing an algorithm named backpropagation. By way of backpropagation, data input is repetitively obtainable to the NNs. With every production the output of the NNs is compared to the requested output and calculated error. This error is after that back propagated to the NNs and utilized to regulate the weights so that the error reduced with every repetition and the neural network model make closely and nearer to creating the requested output. A large number of repetitions needed to get acceptable outcomes. The researcher Adam and Michal in their research presented training using ANNs, their outcomes found utilizing other developmental technique, and gradient training approaches. The goal function telling the ANNs networks training trouble is a multi modal, hence the algorithms depended on gradient techniques be able to simply fixed in local boundaries [47]. Weight modification initiates at the output neurons wherever the error determine is easily obtainable. This process is identified as (training). The MLP gets over the exceeding limitation of the single layer perceptron. The weight alteration is capable of ready layer wise, via going in a backward path. Used for the output layer nodes, it is simple to calculate the fault, when we identify the real result and the requested outcomes. For the hidden layers nodes, as we do not recognize the requested outcome, we spread the error calculated in the last layer backward. The structural design of MLPs network is not wholly restricted by the difficulty must be resolved. For every training data, a pass into forward and a pass into back are achieved. Within the pass into forward computed outputs and the error on output nodes. Within the pass into back utilized the output node error to adjust weights on the output nodes. After that the error on the hidden neurons is computed, and weights on hidden neurons are altered utilizing these values. This is frequent repeatedly once more, till Error in low and passable standard. MLPs may be trained to spread fine during inputs range for which they were trained. Mark, Martin, and Howard illustrate ANNs in their book” Neural-Network-Toolbox, user’s Guide “, they were said and proved that MLPs are completely strong and it may be utilized for both pattern recognition troubles function fitting [48].

### **3.2 Algorithm of Backpropagation**

Back propagation neural network (BPNN) algorithm is the most widespread and the earlier supervised learning. The researcher Shital obtained the adjusted backpropagation algorithm is planned and successfully practical, he proposed that weight can done during some proficient methods possibly included so as to enhance the additional rate of training [49]. Thipsuda and Pusadee make in their research evaluation involving classical discriminate and ANNs, the goal of this research is to learn the efficiency of ANNs. Back propagation neural network learning algorithm has been utilized to train the network. They trained two representations of discriminant analysis and a multilayer supervised NNs depended on the BPNN learning algorithm.

Artificial neural network utilizing BPNN algorithm executes training in support of enhancing effectiveness of MLP model. This confirmed that ANNs are capable of appreciably enhance student prediction correctness while evaluate with discriminate analysis [50]. Back propagation neural network algorithm is an included arithmetical tool. Any data error on the output layer is back propagated to previous, permitting arriving weights to these layers to be modified. But carrying out of training equations is depended on repeated procedures, and therefore is simply executable on a computer. The network training initials through practicing input units and the requested target output. The units of input reasons output reply at every nodes in every layer and therefore, output acceptable on output layer. On output layer, the variation among actual output and target outputs give in error. This error signal based on the weights values of nodes in every layer .This error is reduced, and though this procedure found new weights values. The rate and correctness of the learning procedure that is, the procedure of modifying the weights also based on a feature, identified as the learning rate. The researcher Steven concentrates on MLP through BPNN and compare with the other some technique, he obtained that BPNN networks gave the top general performance [51]. The input reply to the nodes of the next layer, and continue, even comeback is got at output layer, that reply after that is verified by the target. And the contrast the error is computed. After the error distinction on the output nodes, algorithm calculates the average on which the error modifications while modifying node level activity. Until

now, the computations were calculated forward that is from input layer to output layer that is the backpropagation neural network for training happens to comparatively simple. Researcher Craven utilized to back-propagation algorithm technique, he found that this approach when used in classifier of NNs may learn quicker, and with a better gain of training models classified properly [52]. Backpropagation neural network with multilayer perceptron are strong and capacity to solve problems. At the present, previously that output layer and recomputed the output layer weights the algorithms move back one layer in order that reducing output error. The output layer weights means that the weights among final hidden layer and output layer nodes. The algorithm after that computes error output at the final hidden layer and calculates new values for its weights. The algorithm so on estimating error and calculating new weight, affecting layer through backward of layer in the direction of input. So as to estimate the error require identify what the acceptable output must exist. While the input is achieve and the weights do not modify that is when they have accomplish stable status after that the algorithm chooses input target and do again the process. Even though replies progress in a forward direction, weights are computed through going backward. Therefore the given name of this algorithm is backpropagation. Backpropagation algorithm is utilized in layered feed forward artificial neural networks. If select backpropagation approach to design neural network, we are not essentially confined to a feed-forward method to find output of NNs. Conceptually, to give output a forward spread activation and to find weight modifies via backward propagates. This indicates that the artificial nodes are ordered in layers, and transmit their signs forward, and after that errors are spread backwards. Network meets inputs via nodes in input layer, and output network is specified via output layer nodes. Here can be one or more middle hidden layers.

BPNN algorithm utilizes supervised learning, which explicitly that we supply algorithm through examples of inputs and outputs. We desire the network to calculate, and after that the error among real and probable outcomes is computed. The scheme of back-propagation is to minimize this error, till training data learns. The training starts by arbitrary weights. The aim is to modify them in order that the error will be smallest. Supervised learning is commonly utilized to train MLP feed-forward in many neural network applications generally back-propagation algorithm. BPNN models are trained

applying Levenberg-marquardt algorithm, which be regarded as to comprise converge power rapidly. The marquardt algorithm is extremely proficient while training networks and supplies maximum performance in the prediction of information compared to every additional backpropagation algorithm, in addition this is particularly right while high correctness is needed. The researchers Martin and Mohammad were obtained that the marquardt-algorithm is very capable than any of another methods while the network includes no greater than several hundred weights. Even the calculation requisites are more top for every repetition algorithm of marquardt. This is in excess of invented for through the improved effectiveness. This is particularly correct while high correctness is needed [53], and the performance function to be reduced is the amount of errors. The researcher Ozgor made comparing between several training of algorithms. He obtained that the levenberg-marquardt algorithm more rapidly and covers high efficiency of the others [54]. The data set is arbitrarily separated into training and validation. If performance estimated on the validation set not succeed to reduce for six repeated iterations. In order to create network of BPNN, it receiving a number of nodes and arrange for them to be displayed layer. A layer has all its inputs linked to each a previous layer, however not together inside the similar layer. And layer has every its outputs linked to any a subsequent layer, although not together in identical layer. Backpropagation neural networks algorithm are typically completely associated. Precisely that each node associated with the output of the previous layer.

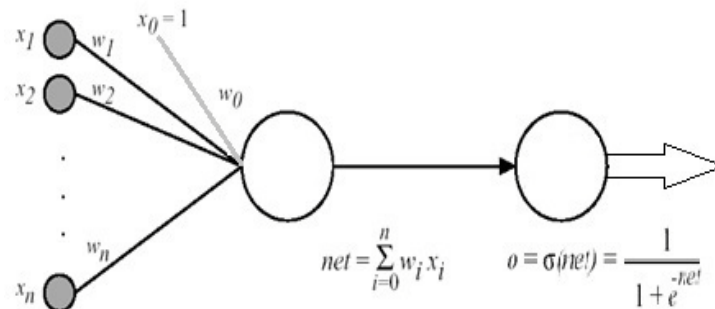
Finally the aim of learns the weights for a multilayer network by backpropagation NNs to reduce error between output and target. Backpropagation have a trouble which can occupy longer to learn but it can resolve these troubles:

- Firstly session on each input to summarize all of the modifies in weight
- Applying the weight

Consequently backpropagation neural network algorithm was greatly used in various areas about the world. Additionally it is extensively applied in the generality functional ANN applications and achieved comparatively fine.

### 3.3 Backpropagation Algorithm for MLP

Presently the more commonly used extensively neural network through a multi-layered perceptron training utilizing NNs algorithm Backpropagation. For MLPs the outputs of one layer will be the input to next layer. The representation of backpropagation illustration in Figure 6 as shown below:



**Figure 6:** Model of forward and backpropagation error

O:  $\sigma(x)$  is the sigmoid function  $\frac{1}{1+e^{-x}}$  ,  $\frac{d\sigma(x)}{dx} = \sigma(x)(1-\sigma(x))$

We may get gradient decent bases to train MLPs of sigmoid units in BPNN, begin every weight as small arbitrary numbers till convinces for every training model, after that perform the following steps:

- Training input in the figure 6 to the network and calculate error for every output node k.  $\delta_k = o_k(1 - o_k)(t_k - o_k)$
- Calculate error for every hidden node h:  $\delta = o_h(1 - o_h) \sum_{k \in \text{outputs}} W_{h,k} \delta_k$
- Then ,Modify every weight  $\Delta w_{ij}$  :

$$\Delta w_{ij} = n \delta_j x_{ij} , \quad w_{ij} = w_{ij} + \Delta w_{ij}$$

In general learning in multilayer perceptron algorithm involving go by forward and error back pending training of network achievement through more widespread the back Propagation NNS algorithm .



## **CHAPTER 4**

### **EXPERIMENT ANALYSIS NEURAL NETWORK SIMULATION**

#### **4.1 Neural Network Simulation**

In this research, the neural network simulation model was executed with a neural network tool and command-line functions with the Matlab software package. By using of the feedback learning with multilayer perceptron the technique capable of fit decision tool to help university admission in the selection of students who possible to succeed in the master plan. The neural network is utilizing to make and analysis choice networks. The network that is chose for applying must have the lowest error average. Usually, more number of layers and more neurons in every layer able to create a superior network with lower error.

#### **4.2 Methodology of the Simulation**

The work run for the simulator neural network plan structural design has some significant tasks which are required chosen done for executing BPL (back propagation method) through artificial neural networks, the subsequently steps proceeding are:

##### **4.2.1 Data gathering and their preparation :**

At first data were collected before starting the design of network process. It is significant that the data cover a collection of inputs that will be utilized network. Multilayer networks have capable of trained to generalize fit in a group of inputs for which they were trained.

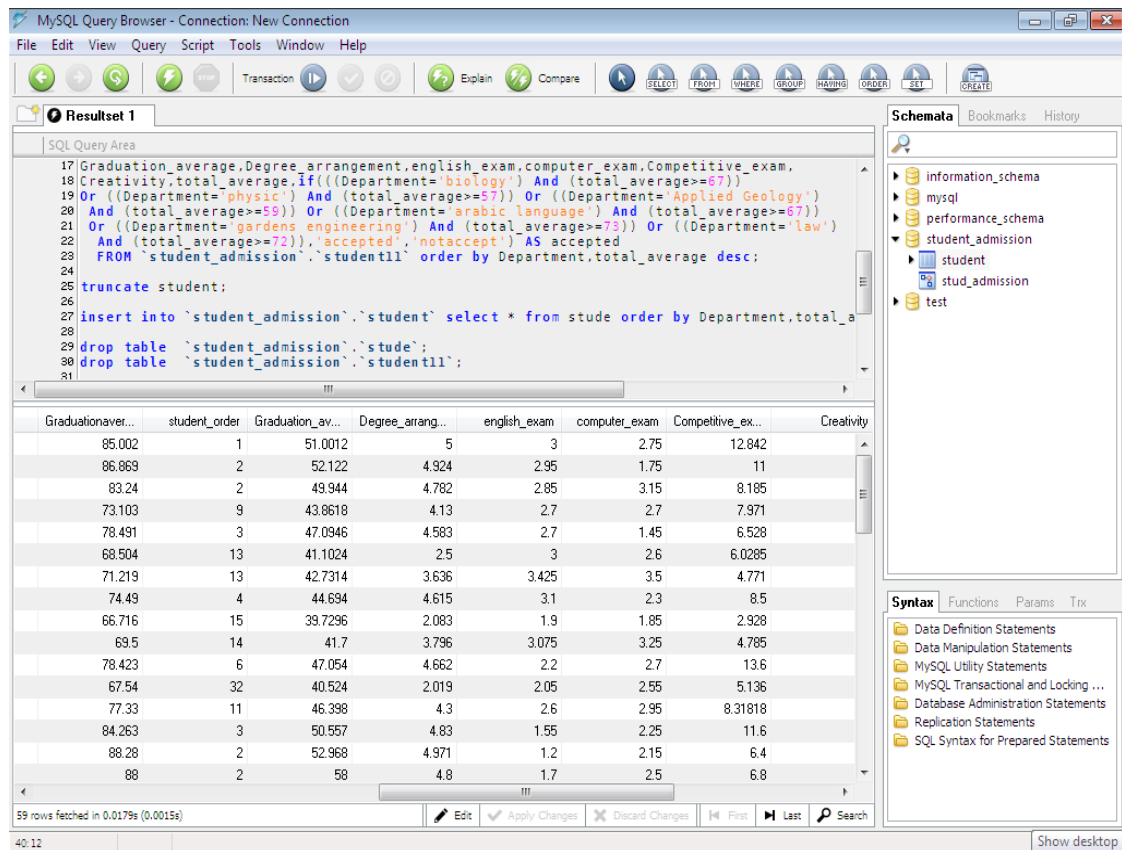
Yet, they do not have the capability to precisely extend outside range. Consequently it is significant that the data training cover the complete range of the input space.

The project were trained and tested with data “student\_dataset” for students admitted to study masters in Kirkuk university (2013-2014).The field of the input variables exercised in this study are:

Fields
Student id
College name
Department
Graduation average 60%
Degree arrangement 5%
English exam 5%
Computer exam 5%
Competitive exam 20%
Creativity 5%
Total average 100%
Approval-acceptance

**Table 1:** Datasets Used in the Study

My Sql server 5.5 is chose as designing and evolving database that is usually used for and embedded applications web. Database created by my Sql, which contains the following information is displayed in figure 7, and perform operations on the data set to discover information. Then export result in CSV format that used for design simulation neural network in Matlab, the dataset and the result showing in PHP.



**Figure 7:** The dataset in my Sql server 5.5

After the data were collected and before the data are utilized to train network, it require to be carried out preprocessed, and we require to be separated into subgroups input data and target data. At this time supervised learning is applied therefore each the inputs and targets which are required for training needs to be collected. In this research the approval acceptance field is characterized the target in this dataset which is views the category of the student acceptance in higher studies or not acceptance, and the remaining fields characterized the input of the network.

You can apply the command `nftool` via using `nntools` to open the tools of NNs. Subsequently load the dataset (student-dataset) via click load dataset in the select data window. Or load dataset via identifying the variables supposes: input “data-student” and targets “approval-acceptance”.

The subsequent small code applying to create the data and choosing the inputs and outputs for training:

```
load student_dataset
inputs = data-student;
targets = approval-acceptance;
```

#### **4.2.2 Create the network design and ANN configuration**

The process of set sizes of network input and output, adjusting of input preprocessing and adjusting of output processing, and weight adjusting to equivalent input and target data is configured. At this point, the network has been used and after that network structure is identified. In this study network will be MLPs. The network includes one or more layers that are hidden as of both the input and output units. In multilayer perceptron the model of each node in the network contains activation function. The network shows high grade of link, the area of which is obtained through weight of network.

- Choosing the layers number: The project is based on multilayer which has includes a three layer ( input layer, hidden layer, and output layer) and was trained applying back propagation algorithm because of BP was confirmed to be the good effective and trusty means to be applied for this study.
- Size of input layer: Number of input units based upon factors number contained in the model, in this study students who wish for enter higher studies should submit to these factors previous to a student are accepted into every university for higher studies which is involve graduation average, English exam, computer

exam, competitive exam, and the total average is evaluated depended on these factors, these factors utilized as input for the ANNs. These factors were translated into appropriate configure for neural network.

- Hidden layer: There is no simple technique to obtain the best hidden neurons number without training via using hidden units number and approximating the error of all. The optimal method to find the most excellent hidden neurons number is test. Essential decision as regards the total of neurons to be utilized in every layer and selecting the suitable nodes transfer functions, in this study utilized one hidden layers that is includes 8 neurons. Afterward, you might want to enlarge this number if the performance of network training is reduced.
- Size of output layer: Comparison the output result with the target, and the error is computed and is spread back to the network, where the weights are set.

In this project, The network has one output node, because there is just one target value linked with every input vector, hence just one node and one output required for selecting the student accepted in higher studies or not depended upon total average that affect to student admission.

The artificial neural networks structural design which used in this study was shown in table 2:

Factors	Value
Inputs number	7
Hidden layer size	8
Outputs number	1
Network type	MLP / Back propagation

**Table 2:** The Configuration Used for the Neural Network

Build a network via the nftool (neural network fitting tool) for estimation problems that supplies a graphical user interface and also command line coding of designing and training a neural network for resolving estimation of fitting problems. The networks designed via nftool are represented via One hidden layer (the number of hidden neurons may be modified via the user. Additional neurons need further calculation, and they have a gradient to over fit the data while the number is set also high, however they permit the network to resolve additional difficult problems. Further layers desire additional computation, however their utilized might result in the network resolving difficult problems more proficiently. Get in the hidden layer sizes as components of an array in the command (`fitnet`) to apply more than one hidden layer. The subsequent code showing make fitting network in this study via the nodes value in hidden layer which is set to 8:

```
hiddenLayerSize = 8;  
net = fitnet(hiddenLayerSize);
```

To select processing functions of input and output cell by the next statement:

```
net.inputs{1}.processFcns = {'removeconstantrows','mapminmax'};  
net.outputs{2}.processFcns = {'removeconstantrows','mapminmax'};
```

These above functions applied to transform values of the input and target, you supply into values that are good suitable for network training through adjusting network properties after you design the network.

The configuration and setup separation of data for training, validation, testing through these settings, the validation and test data are displayed in this script and in the table 3 shown below. The validation and test data sets are all set to 15% of the actual data, and remain input and target will be arbitrarily partitioned, with 70% it's for training dataset:

```
net.divideFcn = 'dividerand'; % Divide data randomly  
net.divideMode = 'sample'; % Divide up every sample  
net.divideParam.trainRatio = 70/100;  
net.divideParam.valRatio = 15/100;  
net.divideParam.testRatio = 15/100;
```

Stage	Sample
Training	70
Validation	15
Testing	15

**Table 3:** Number and Percentage of Each Stage

### 4.2.3 Train the network

Training in this research using MLP and achieved through 2 stages: forward and backward. Back propagation algorithm is generally utilized algorithm for training MLPs network. Execution for back propagation algorithm is mainly initialization of weights are accomplished with specifying arbitrary weights values after that input gets its input signal and carries its signal to every layers on top of it. Every hidden neuron sums its weighted input signal then after executing activation function. It is converted to output neuron every output neuron sums weighted then its activation is also computed. All output neurons obtain a target to corresponding to input signal and computes error after that weights are adjusted then this similar computation is executed on hidden layer, for every training functions code (nntrain).

The network trained through backpropagation training algorithm depended upon a levenberg-marquardt method (the conforming Matlab code is “trainlm”), I choose a training algorithm levenberg-marquardt (trainlm) because it is suggested for most troubles. Then press on train, the training continuous till error validation unsuccessful to reduce for iterations.

```
net.trainFcn = 'trainlm'; % Levenberg-Marquardt
```

To select a function of performance the learning process is supervised using a cross-validation method depended upon a arbitrary separation of the first set of data in three subsets: for training (weights set), for learning process control (validation) and for estimation of the excellence of estimation which is testing. Functions code (nonperformance). The estimation good be evaluated by:

- Mean Squared Error (MSE): it describe distinction between to correct outputs and those suppllied through the network; the estimation is good if MSE is smaller (nearer to zero).  
`net.performFcn = 'mse'; % Mean squared error`
- Correlation coefficient (R): it connection measurement through correct outputs and those suppllied via the network, R is nearer to (one) then the estimation is good.

To select functions plots regression. This is executed to confirm the performance of network. Show the histogram of error to find further investigation of network performance.

```
net.plotFcns = {'plotperform','plottrainstate','ploterrhist', ...  
  'plotregression'};
```

At last abstract the algorithm of levenberg-marquardt back propagation is applied for network training. Training stops automatically while generalization stops enhancing, as specified through a raise in the mean square error (MSE) of the validation models. The MSE is the average squared distinction through outputs and targets. Lower values are good as zero indicates no error. Regression (R) is executed to calculate the correlation through outputs and targets.

```
[net,tr] = train(net,inputs,targets);
```



#### 4.2.4 Test the network and validation (training analysis)

Lastly testing is achieved on hidden data is accomplished utilizing testing set. This will obtain precision of our created model. After the network was trained network is then tested to calculate the output of the network. The following code computes the network outputs, errors and generally performance:

```
outputs = net(inputs);  
errors = gsubtract(targets,outputs);  
performance = perform(net,targets,outputs)
```

At this point of compute performance of training, validation and test, we may test the network next to new data. If you are unsatisfactory with the efficiency of network on the actual or new data, we may make one of the following:

- Retrain again.
- Enhance neurons number.
- Obtain a better training data set.

If the efficiency training is good, but the test set effectiveness is considerably bad, which could show over fitting, and then decreasing the neurons number may enhance your outcomes. If performance of training is reduced, after that you may want to enlarge the neurons number. As satisfied with the network performance, click next. I can utilize the created code or diagram to improve recognize how your neural network calculates outputs from inputs, and apply the network with Matlab tools.

```
trainTargets = targets .* tr.trainMask{1};  
valTargets = targets .* tr.valMask{1};  
testTargets = targets .* tr.testMask{1};  
trainPerformance = perform(net,trainTargets,outputs)  
valPerformance = perform(net,valTargets,outputs)  
testPerformance = perform(net,testTargets,outputs)
```

Following the network response is acceptable, and we can currently set the network to apply on new inputs and show the diagram of network.

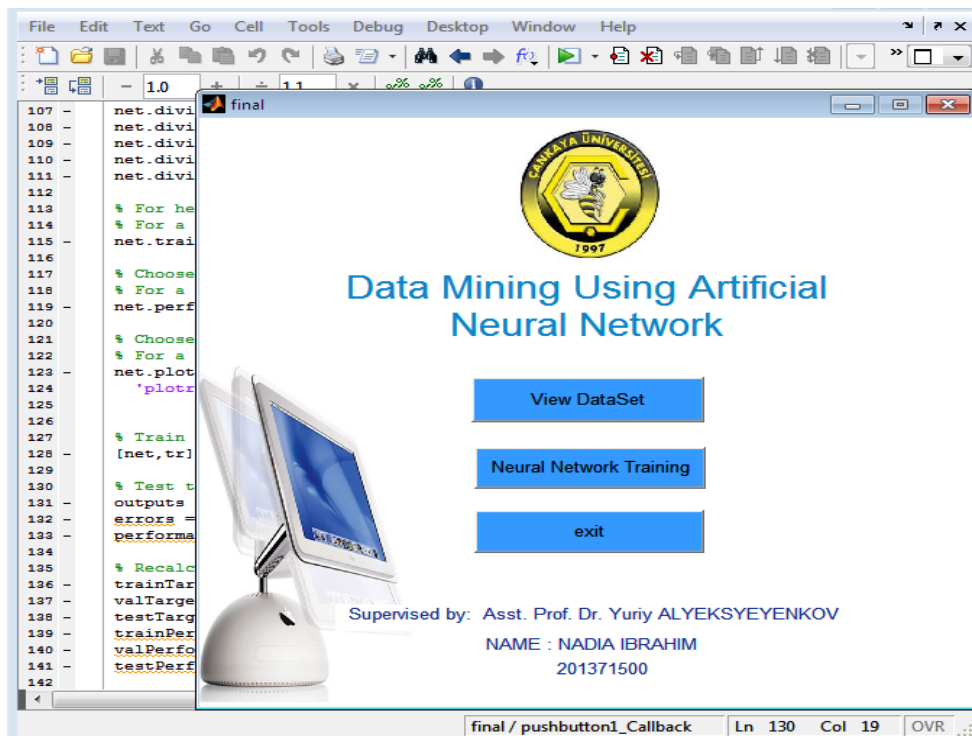
```
view(net)
```

## CHAPTER 5

### THE RESULTS ANALYSIS

#### 5.1 Performance Evaluation

In this research the experimental results are simulated with the software Matlab R2011a and executed by using MLP technique on the back-propagation scheme to train the data set of student. We have created the neural network model by the train data set and various the activation functions linked with the layers of the network and studied its outcome on the classification of data and MSE found in the results. After you execute the program in Matlab show us a window as shown in the figure 8 below:



**Figure 8:** The main interface of this research

The figure 8 contains commands of performing the tasks in this program, this commands executes a precise process in requisites of through this interface is access to the sub-form by clicking the commands of the model. It also includes the name of the project and my name and the name of the professor supervising the project and provides information concerning the functions and tasks executed by the program by clicking the (commands). This window represents the main interface in this system, in addition, the ability to be able to get out of the system.

- Now when you press a button (View dataset) in the main window will show the data used in this project via PHP which is designed by my Sql server 5.5 will as illustrated in the following figure 9:

Graduationaverage	student_order	Graduation_average	Degree_arrangement	english_exam	computer_exam	Competitive_exam	Creativity	total_average	ac
75.123	2	45.0741	4.872	3.15	3.45	13	0	70	ac
74.559	3	44.735	4.744	3.05	2.65	11	0	66	ac
74.49	4	44.694	4.615	3.1	2.3	8.5	0	63	ac
65.821	3	39.492	4.545	2.7	2.9	11.5	0	61	ac
71.804	6	43.082	4.359	2.25	2.2	7	0	59	no
71.467	7	42.88	4.231	2.75	2.05	7	0	59	no
84.263	3	50.557	4.83	1.55	2.25	11.6	0	71	ac
83.688	2	50.212	4.93	1.05	1.8	10.8	0	69	ac
80.001	10	48	4.63	1.65	1.95	13.2	0	69	ac
81.89	3	49.134	4.74	1.65	2.9	9	0	67	ac
79.391	5	47.634	4.48	1.05	1.65	10.8	0	66	no
82.307	3	49.384	4.86	1.15	1.2	8.4	0	65	no
82.01	3	49.206	4.8	3.05	3.75	12.4545	0	73	ac
80.6	5	48.36	4.6	2.45	3.55	14.4545	0	73	ac
82.52	2	49.512	4.9	2.425	2.6	12.1364	0	72	ac
80.51	7	48.306	4.4	1.9	2.75	14.4545	0	72	ac

**Figure 9:** The dataset of this research

These data graduating students and students must provide these factors which depend on them to accept the competitor's students in graduate studies. We require to be divided the dataset used into input data and target data before training these dataset. The target in this dataset which is characterize by the approval acceptance field is views the student acceptance evaluation in higher studies or not, and another fields represented as input for the NNs in this system. These fields were changed into a format fitting for NNs.

- After that while we press the button (neural network training) in the main window (figure 8) move to the second window, which is the main part in this project, where shows detailed information in this Project. The training continued until the validation error after the process of training is utilize choices for show graphs to estimate the performance in addition to get. These results as shown in figure 10:

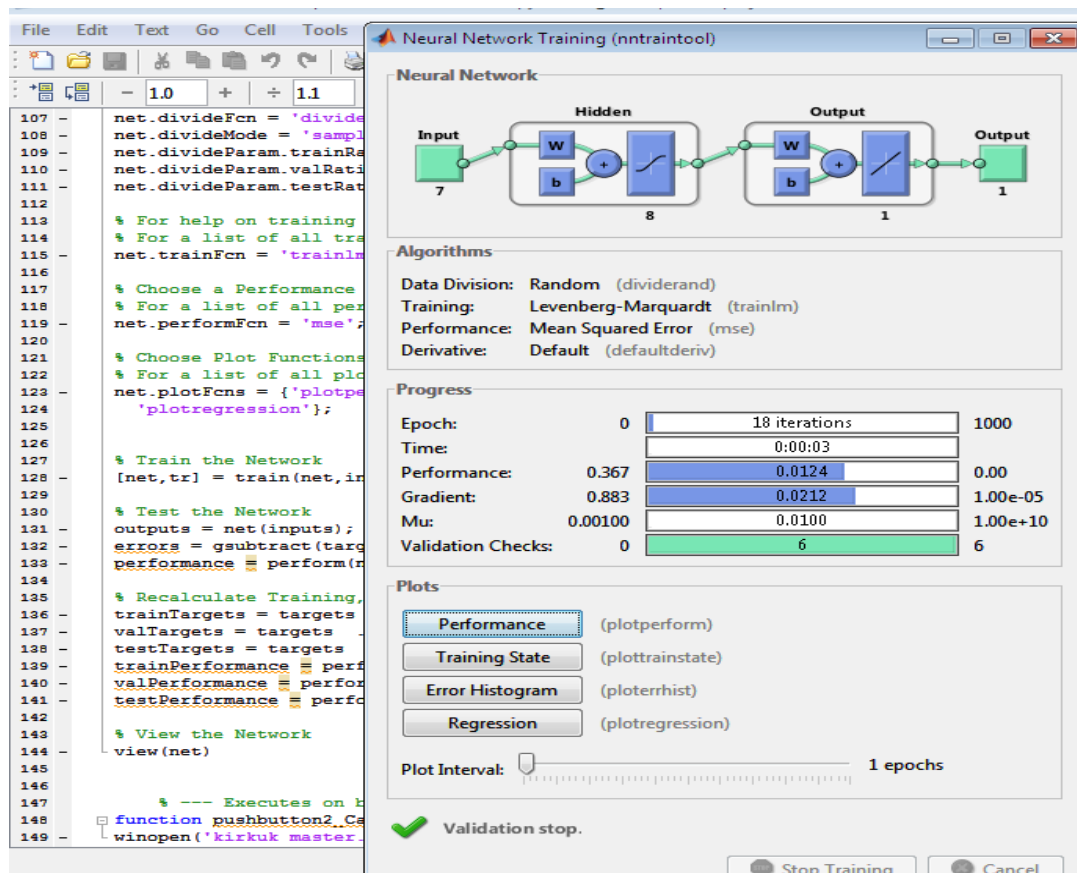
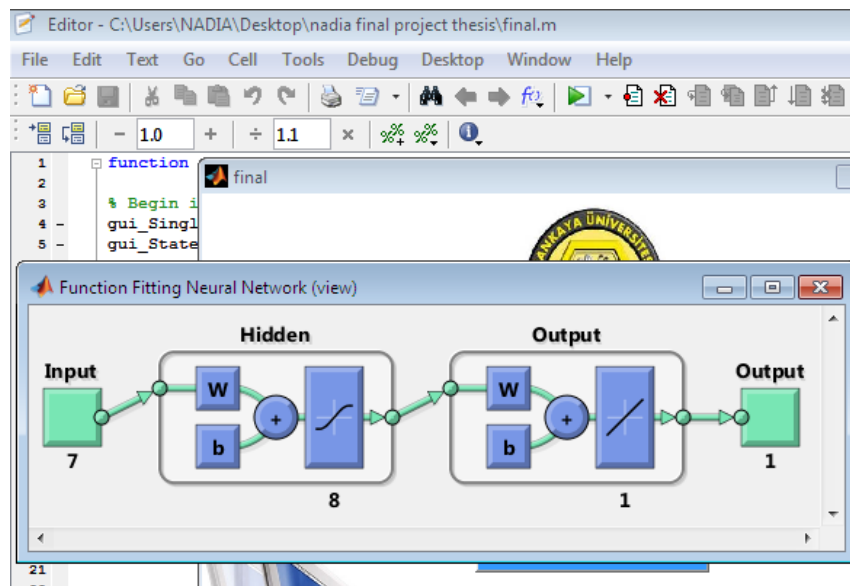


Figure 10: MLP neural network training by the Matlab

The figure 10 displaying the process training of neural networks windows with two hidden layers for training. Additional figures show time, performance, gradient and validation verifies utilized for training and testing of NNs. The results found of the training part are given the number of highest proposed iterations to obtain the results is 1000 which is the entire numbers of epochs are applied, as the neural network terminates training at iteration number 18. The time which used for achieving the training was 3 seconds. Also this figure shows the feature of the algorithm applied, variety of error selected for training the network that is mean square error and we can also see the performance diagram and the regression diagram from it. This sketch in addition provides us value of the error founded while training the network.

- Illustrates the architecture of the model created and how input are associated to hidden layers and additional hidden layers are linked to output layer and the used topology in this study is identified. In figure 11 we found that we use 8 neurons in hidden layer in this network, and the network has 7 inputs and 1 output. We categorize all input data to groups, arbitrarily and exercise some data for educational model, evaluation and the others used for network test. The results study of training and testing is given in figure 11:



**Figure 11:** Architecture of the neural network created by the Matlab

## 5.2 Results Discussion

- Press a button (performance) in figure 10 to illustrate the performance chart of the proposed network when trained with algorithm of levenberg-marquardt backpropagation using Matlab R2011a to predict input as shown the figure 12 below which is shows the illustration of MSE through the training of all iterations of 18.

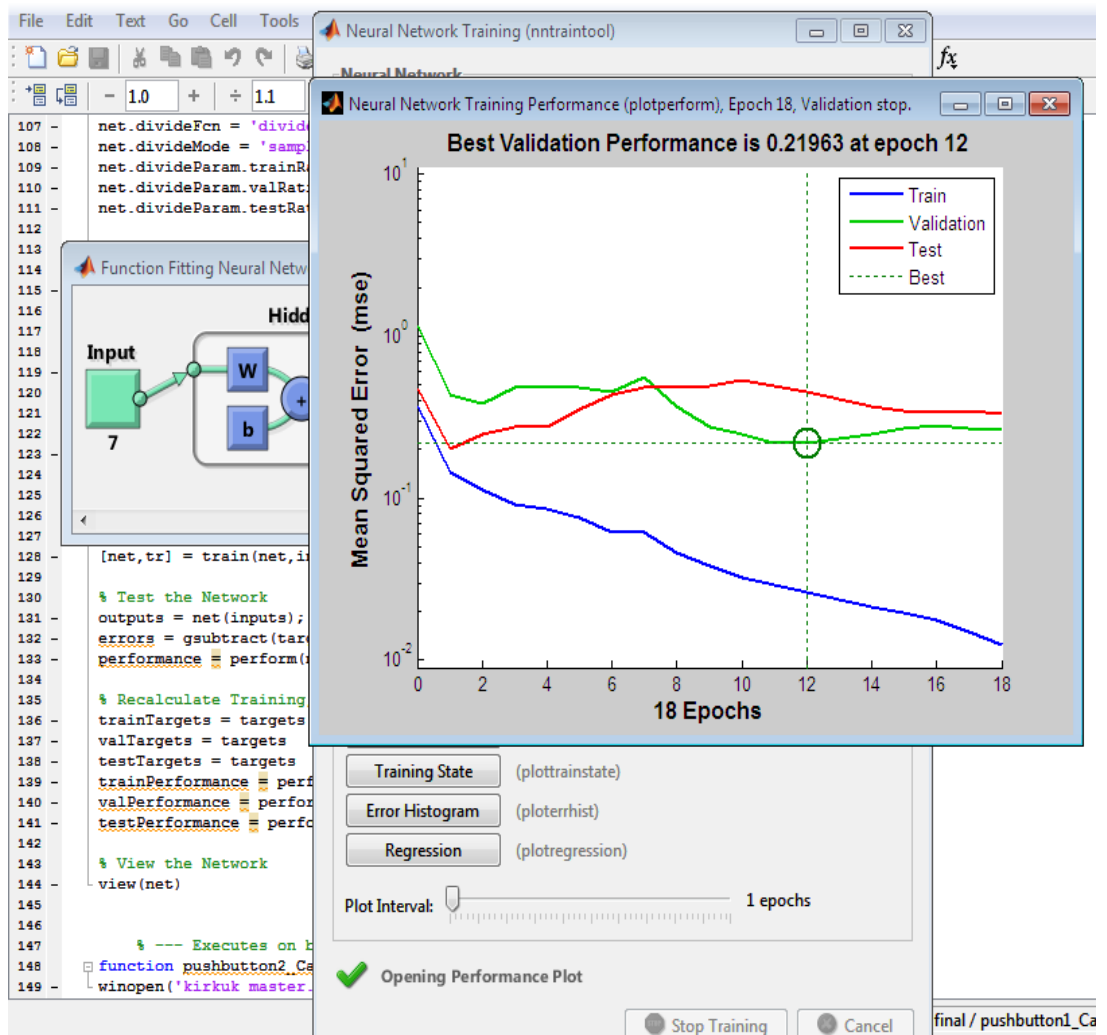
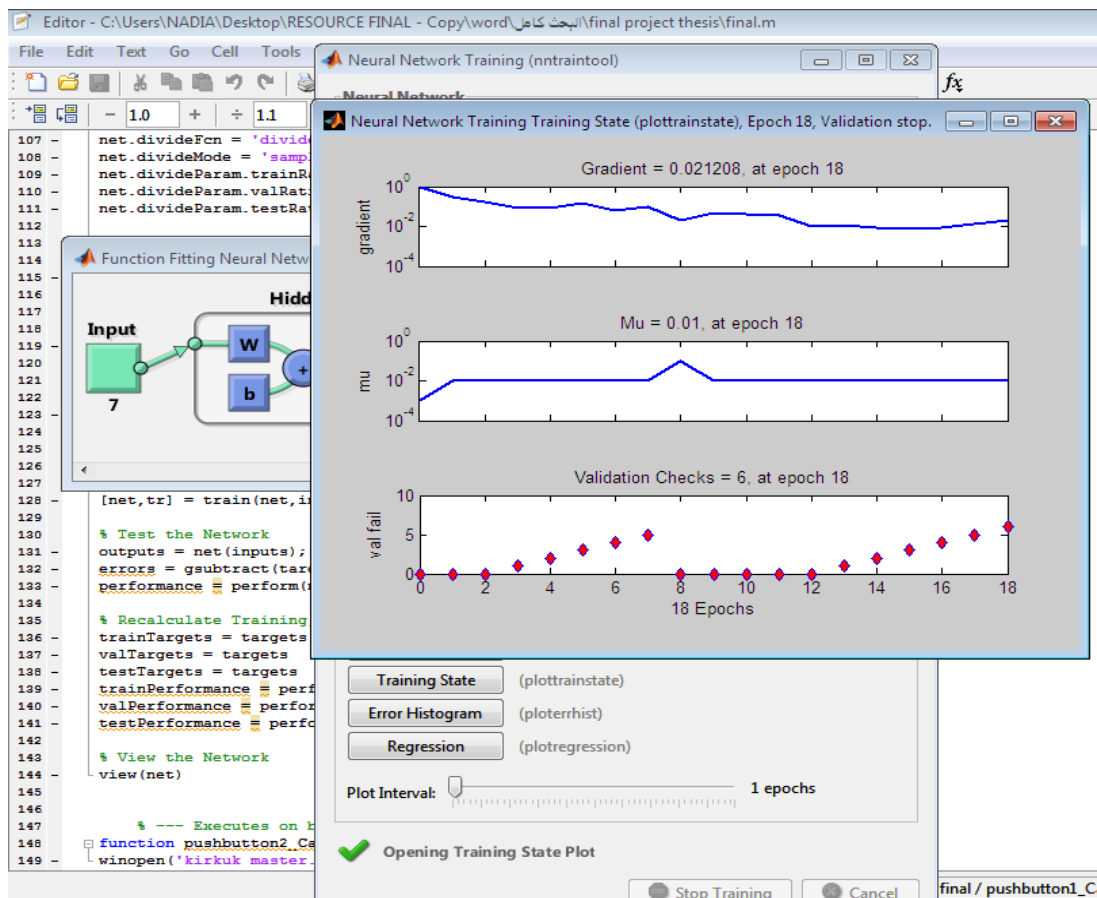


Figure 12: Diagram of training, evaluation and testing error of NNs

In network learning, it is essential to remind that mean square error function is choice to distinguish efficiency of network. To obtain executed expectation value and actual values, it is used error function theory. It is in addition used mean square error to evaluate expectation error, and the mean squared error is the average squared distinction through outputs and targets. Minimum average is good however MSE is zero means no error. From the figure 12 above, we found that the learning practice is occurred in 18 repetitions. As well the chart of learning errors, estimation errors and test errors are gave in figure 11; it is obvious that the best performance and greatest efficiency of the network 0.21963 is happened in epoch 12.

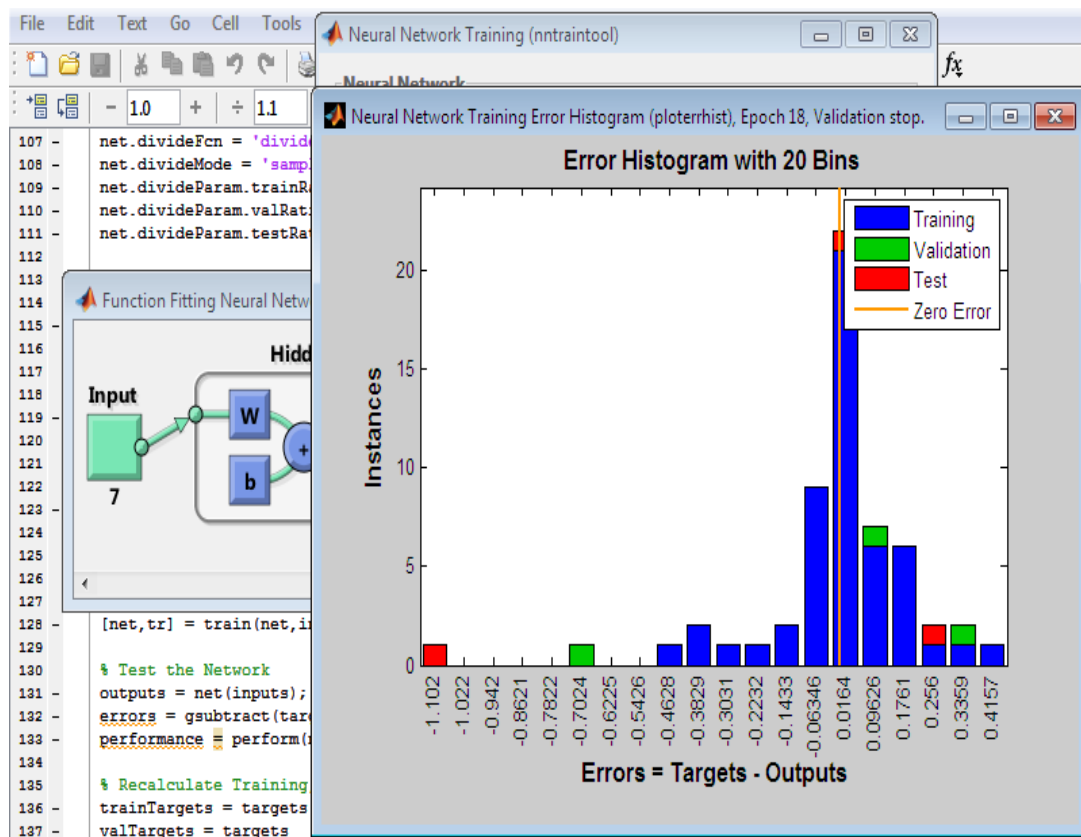
- Press a button (training state) in figure 10 to demonstrate the function of learning data and The Figure 13 below shows the performance of the neural network consisting difference in gradient coefficient with value to Mu, number of epochs, and validation check in repetition 18:



**Figure 13:** Plot training state performance results diagram of NNs

The figure 13 above illustrate the training State, that the concluding value of gradient coefficient at epoch number 18 is 0.021208 which is approximate close to zero. Smallest the assessment of gradient coefficient good will be training and testing of networks. The gradient value lessening with enhance in number of epochs. Also from figure 12 it can be seen that  $\mu = 0.01$  at epoch 18, and validation checks= 6, at epoch 18.

- Click a button (error histogram) under the plots pane (figure 10) to specify the error histogram of learning step to find further verification for performance of network as shown in figure 14:

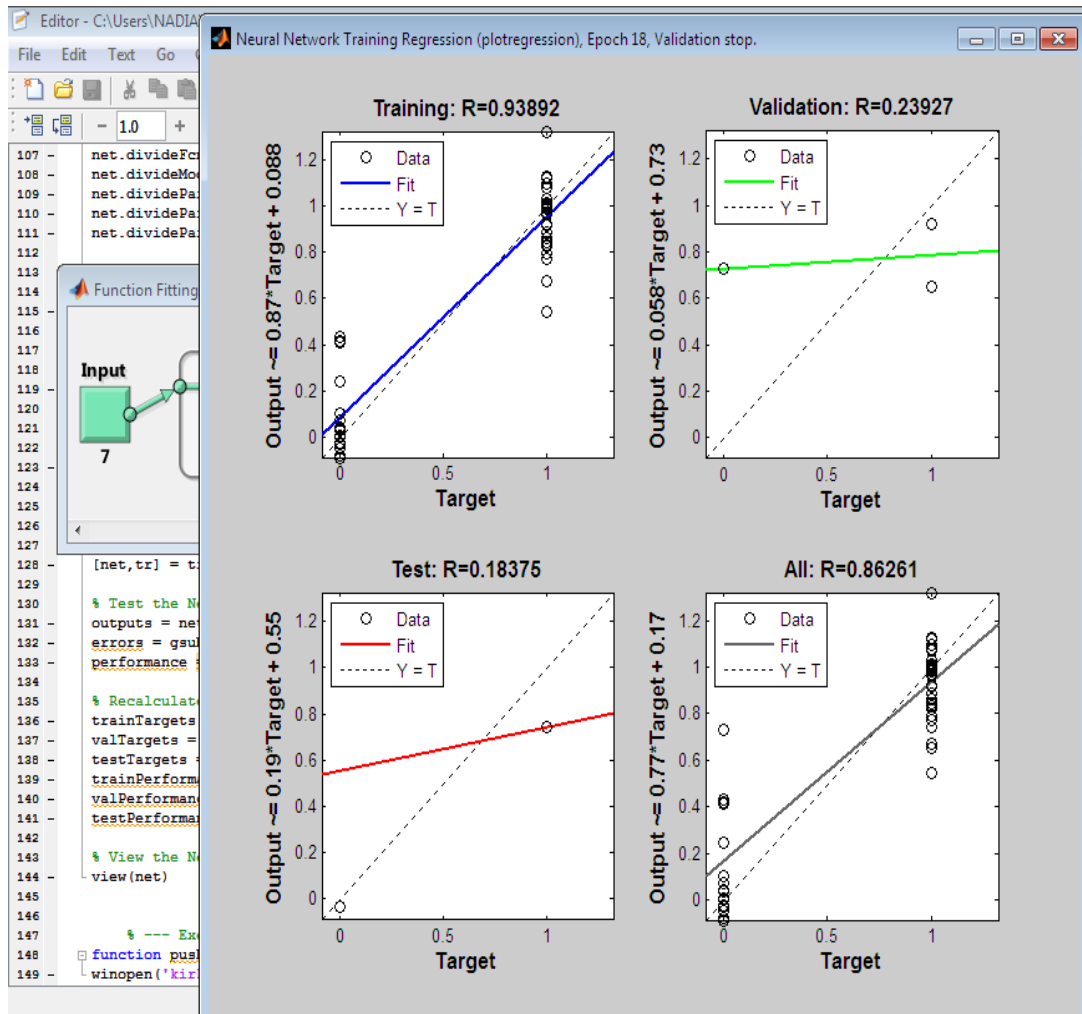


**Figure 14:** Error histogram in training



The results are displayed for a reliable tool where the vast majority of the low-error is to a large extent. The blue color displays training data, the green color characterizes validation data, and the red color describes testing data. The chart offers an indication of the extreme values, which is where the data points fit greatly not as well as the data majority. In this status, you can observe that the training with an error of 0.4 and validation with errors of 0.3. These outliers are moreover able to be seen on the regression plot for testing. It is an excellent scheme to verify the outliers to find if the data is poor, or if these data are diverse than the other of the data set. If the outliers are distinct from the rest of the data however are valid data then the network is concluding for these points. You must gather more data that such as the outlier points, then retrain the network.

- At final click a button (regression) in the training window (figure 10) to carry out a regression between the outputs of network and the conforming targets and executes some analysis of the network reaction. This is utilized to authenticate the network performance. The next regression plots exhibit the network outputs with regard to targets for training, validation, and test. Regression plot displays the link through the outputs and the targets of the network. If the training were great, then the outputs of network and the targets would be precisely equal, but the correlation is not often idealistic in exercise. Regression plot has given the data are fitted the line while the training is entire. The following regression plots in figure 15 view the outputs of network with consider to targets for training, validation, and test. For an ideal fit, the data ought to drop out the length of a 45 degree line, while the outputs are corresponding to the targets of network. For this trouble, the fit is practically superior for each datasets and R values in every status of 0.9 or higher than it.



**Figure 15:** The regression analysis plot results of training

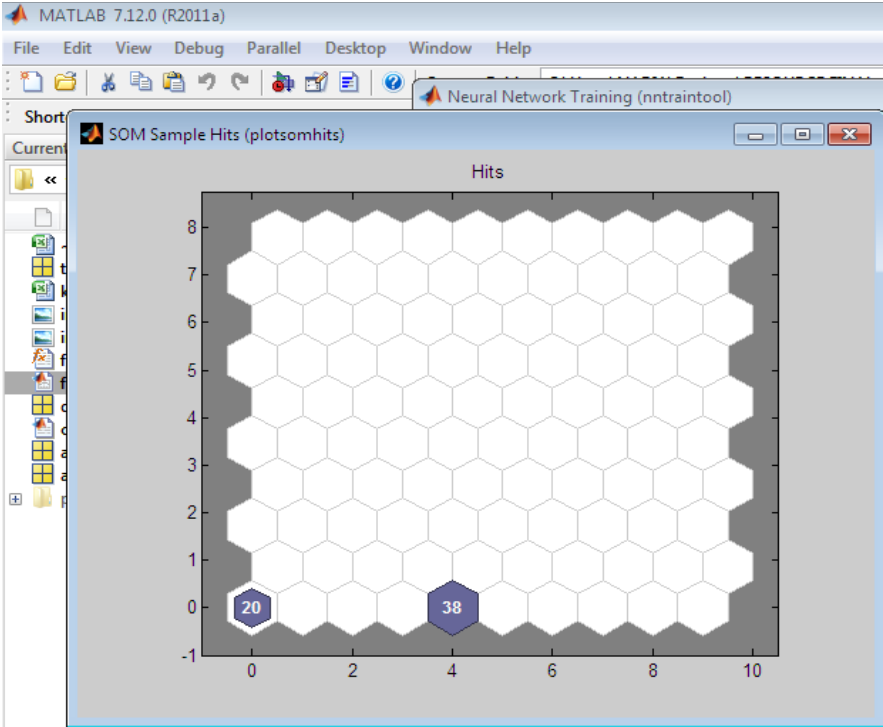
The four regression schemes characterize the training, testing, validation, and each that. The dashed line in all plot describes the great result – outputs = targets. The solid line shows the greatest fit regression line through outputs and targets. The analysis of regression R value is executed to presentation of the correlation between outputs and targets. If R is near to zero, then there is no correlation among outputs and targets, An R value of 1 means an adjacent connection, zero represents an arbitrary association. The figure 13 illustrates the output paths the targets good for training, testing, and validation, and the value of R is 0.86261 for the overall response. The results of regression as using  $R = 0.93892$ , the target procedure (output= 0.87 target + 0.088) for the training were close to the target which is represent by slope line and the fits of data in every iterations.

For this study, the data of training illustrates a great fit. The subsequent table 4 shows the values of MSE (mean square error) and regression (R).

	R	MSE
Training	0.93892	0.0261
Validation	0.23927	0.2196
Testing	0.18376	0.4565

**Table 4:** MSE and Regression Through Training, Validation and Testing

- With neural network training also displays the following figure 16 shows that neurons display the number of inputs in order to classify and as shown below



**Figure 16:** The plot of sample hits

The results of figure 16 obtained that the number of student acceptance in higher studies is (38) and the number of student not acceptance is (20).

- Finally, after pressing the exit button the program will be ending.

## **CHAPTER 6**

### **CONCLUSION**

In this research, data mining was discussed by using one of DM methods which is (neural network technique) we have to benefit of DM process in the student dataset to evaluate students performance data and to improve the superiority of practical educational project. We applied NNs techniques on student's data. Data mining applied to recognize and discover unidentified samples in dataset. The student data includes hidden information for expecting student's efficiency.

We obtained in my studies that the neural networks could perform a useful role in experiencing to solve several issues in choosing students for university admission. Our study has shown that the information produces after the DM methods analysis on student's dataset is beneficial to student admissions and decision making of training. IN my research determined that factors which are making acceptance decisions must consisting elements that can be resulting in difference in student efficiency in examinations and student depended on these. It could consequently be important to get together these factors in order that they achieve influence on the whole performance of students. Therefore, we conclude that ANN is further strong and might be applied in dataset of student high correctly from other admission of the student over the all years. The neural networks is the most appropriate, more precise achieved, and supply the best possible performance of all the estimating neural network models for this specific trouble and test data. The link through the features and performance was assessed and obtained that several features very influencing the student's performance. Therefore, this technique might support the department to improve efficiency of their students.

We conclude that outcomes depended on neural networks model show the greatest performance 0.21963. While the result value in the regression plot is  $R=0.86261$ , that is to say it the good number and perfect value, which shows that result through the target and output is the equivalent. The outcomes propose that the ANNs design can achieve high-quality prediction with smallest error; at last we reached that this neural network possibly will be a significant implement used for prediction. In our approach we illustrate that the applying of supervised neural networks for student dataset is very proficient and capable to considerably develop student graduation. It is supposed to work in the future in the use of artificial neural networks to concentrate on feature more performance for the benefit to be used as data entry. As well as to decrease the error rate in addition to the design neural network for student dataset extended for many years. Also we would like to make application of artificial neural network using a database in other areas. Additional improvement and evaluation to this module is intending to do in the close future to obtain better outcomes. As well more work may be executed to improve the precision of classification by using various neural networks structures. I have observed that this technique is flexible adequate that it be able to expanded by widely studies or different data sources.

Finally it has been found that the back-propagation MLPs using the artificial neural network are applied because of the ability to resolve very difficult troubles, as well their robust, giving the greatest results, and it is achieved that the efficiency is improved.

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## APPENDIX

### CURRICULUM VITAE

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#### EDUCATION

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#### FOREIN LANGUAGES

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