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The Use of Neural Networks in Predicting Children's Creative Ability in Preschool Education

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ABSTRACT: The article examines the utility of neural networks in determining the inventive ability of preschoolers (Preschool Education Organization - PEI) before the beginning of training. On this premise, feed-forward (FF) neural networks were chosen. Components influencing children's ability to master were chosen by conducting a Spearman correlation test. According to the results of the correlation test, information on children's interest in activities, age, gender, and parents were selected as factors in the construction of neural networks. 75% of the results of the study in PEI were used to train the FF neural network, 25% to check the proper working of the neural network. As a result, moved forward neural networks achieved the required result and a Windows application were made to create it simpler to use.

KEYWORDS: neural networks, feed forward, back propagation, feedback, correlation test, trainee, ability, regulation, experimental analysis, intelligent system, cognitive development.

I. INTRODUCTION

In recent years, in developed countries, PEIs have been almost completely equipped with personal computers. Subsequently, computer technology programs can be effectively used within the educational process in these preschool educational institutions [1]. Nowadays, determining the abilities of students and coordinating the educational process to the interests of the child plays a vital part within the upbringing of a harmoniously developed generation.

The use of data and communication technologies in working with preschool children in modern society can be used to realize different developmental effects on preschool children, counting the cognitive development of preschool children [2]. To date, the predictive capacities of regulatory calculations in artificial neural networks, comparative empirical studies of social data [3], and the use of artificial neural networks in predicting children's abilities have been the subject of various logical ponders. Preschool students will require a program composed of a mathematical model and algorithmic programming dialect to utilize neural networks in predicting the creative ability of pupils.

II. THE MAIN FINDINGS AND RESULTS

A. BASIC CONCEPTS AND DEFINITIONS.

A.1. Neural network

The neural network is one of the ranges of research within the field of artificial intelligence based on attempts to extend the human nervous system. Neural networks have numerous important features, but the key is the ability to learn. The study of neural networks fundamentally involves changing the "strength" of synaptic connections between neurons. The main ranges of application of neural networks include estimating, choice-making, pattern recognition, optimization [6], data analysis.

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A.2. Artificial neuron network a classification

An artificial neural network is a brilliant system that comprises connecting work and a certain number of artificial neuron-based connection weights, has the capacity to cope with nonlinearity and flexibility, and is widely used in counterfeit intelligence [7 - 10].

Feed-forward (linear) neural networks (FF) are artificial neural networks in which neurons never form a cycle [11]. In this neural network, all neurons perform the input function for the neurons before them. The last layer of neurons is called the output. All the layers between the input layer and the output layer are called inactive layers (because they have nothing to do with the external environment). In FF neural networks, each neuron in one layer is associated with each neuron within another layer. Hence, all neurons in this network are completely connected. There's no reversal in the FF neural network. Subsequently, to play down the blunder within the prediction, we typically use an update of the weight values i.e. the backpropagation algorithm (Figure 1).

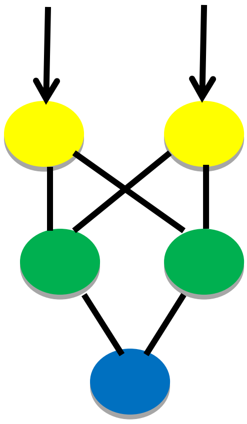

Figure 1. Feed forward neural network

Figure 1 shows a Feed-forward (linear) neural network with two input neurons, one latent layer, and one output value. In this case:

• yellow neurons in the first layer represent input neurons;

• green neurons in the second layer represent latent layer neurons;

• the blue neurons in the third layer represent the output neurons.

Recurrent neural networks (RNNs) are different from linear (FF) neural networks. In this sort of network, each of the neurons within the idle layers is gotten to with a particular modification. RNNs can process inputs and share any length and weight over time. That is, it also takes into consideration previously obtained data. However, the computational speed of this neural network is low. The RNN neural arrangement is shown underneath (Figure 2).

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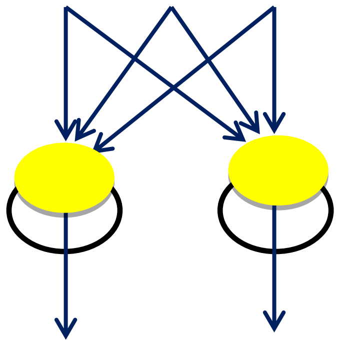

Figure 2. Recurrent neural networks

B. PROBLEM STATEMENT.

B.1. Analysis of factors influencing the creative ability of PEI students

The creative ability of PEI trainees depends on numerous factors. In this study, children's demeanors toward learning, information about their parents, gender, and age were chosen as input values. At PEI No. 16 in Karshi, the results of an try conducted on 88 trainees were used to train the network and test the result.

B.2. Attitude to training

The children's attitudes towards the lessons were assessed by the educator on a 5-point scale. Children with very high interest in the lessons are given 5 points. Children who do not want to learn can be assessed up to 2 points.

B.3. Information about parents

We believed that children's capacity to master the lessons was straightforwardly related to their parents. For illustration, in the event that the father and mother have higher education, the child of such a family will master the lessons according to the results of the experiment. The entry value for such children was set at 2 points. If the father or mother has higher education, it was assessed with 1 point. In addition, cases were rated points.

B.4. Gender

We found that children of different genders may have different learning habits, i.e., gender also influences children's ability to learn, and without a doubt, it was found that the proportion of girls in this respect is higher (Figure 3).

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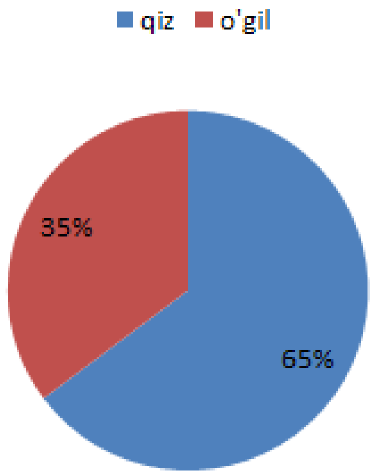

Figure 3. Gender distribution of children.

B.5. Age

Age has a significant effect on the ability of learners to assimilate. Therefore, this value was accepted as the input values. The ages are distributed in the following diagram (Figure 4).

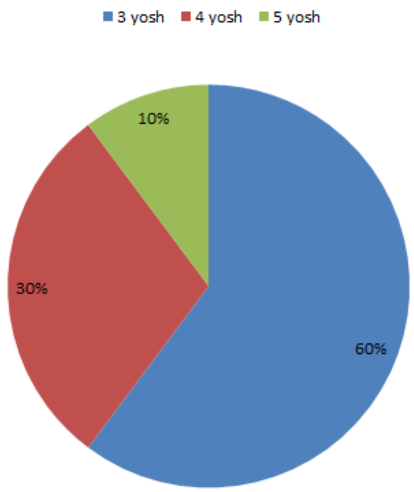

Figure 4. Age distribution of children

B.6. Correlation test

The extent to which the above factors affect children's creative ability was examined by Sperman's correlation test (Table 1).

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Table1
Spearman correlation test results

Factors	Correlation coefficient r	P
Attitude to training	0.8528	0.03091
Parent information	0.43301	0.39108
Gender	0.1118	0.83299
Age	0.6923	0.05302

Table №1 shows that children's demeanors and age have the most noteworthy impact on their imaginative mastery. The correlation coefficients of the two were 0.85 and 0.69, respectively. Age and gender also play a role. In the correlation test, girls were calculated by setting 1 as for boys [12].

C. PROBLEM SOLVING MODEL.

C.1. Study ability prediction model based on neural network

C.1.1 .Improvement of the neural network

FF neural networks are neural networks that are simple in structure. The network typically uses a backpropagation calculation to update weight values. The choice of the number of neurons in the latent layer has a major impact on the predictive accuracy of the model. The very little number of neurons increments the model training time and affects the accuracy of the exercise. In addition, a large number of neurons had to train a part, prolonging the training time of the network. In this study, there was minimal error when there was one latent layer and 4 neurons.

C.1.2. Perform neural network-based prediction.

Let us consider the prediction of the creative ability of pupils using FF neural networks [13-17]. The following table partially analyzes the results of the experiment with the pupils of MTT No. 16 in Karshi (Table 2):

Table №2

Experimental analysis table

Name	Type of training	Time	Age	Gende r	Passion	Parents	Result
Aziza	Memorize 5 proverbs	5 days	6	0	3	2	90 %
Ezoza	Memorize 5 proverbs	5 days	5	0	4	1	80 %
Oybek	Memorize 5 proverbs	5 days	4	1	3	2	50 %

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Shodiyona	Memorize 5 proverbs	5 days	4	0	4	0	60 %
Islom	Memorize 5 proverbs	5 days	4	1	3	1	55 %
Ahadbek	Memorize 5 proverbs	5 days	3	1	2	2	25 %
Shahlo	Memorize 5 proverbs	5 days	6	0	5	1	95 %

The experimental investigation table consists of several columns of №2. The values are given within the age, gender, passion, and parent columns are the input values of the FF neural network. As specified above, the network comprises of a single hidden layer. Figure 5 shows the neural network graph beneath consideration.

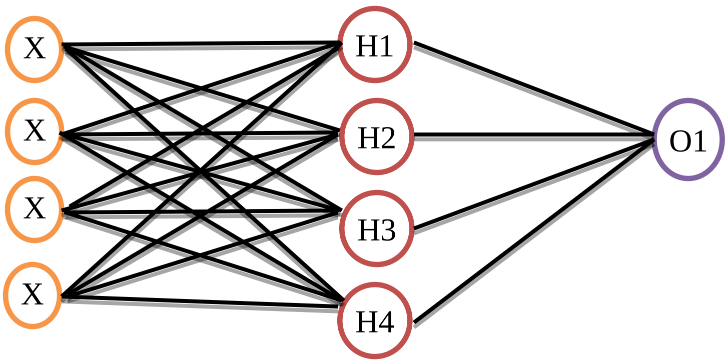

Figure 5. FF neural network

Here, x1, x2, x3, and x4 are the values given in the age, gender, passion, and parent columns, respectively. We use the loss method to train the neural network. In such cases, the mean square error of error (MSE) is used [18].

$$MSE = \frac{1}{n}\sum_{i=1}^{n}(y_{true} - y_{pred})^2 \quad (1)$$

Here:

• n- In this case 66. 75% of the results of the experimental analysis;

• y- estimated variables;

• y_{true}-- is the true value of the variable, i.e. the correct answer. For example Aziza will have 1 (90%);

• y_{pred}- estimated value of the variable. This is the output of the network.

(y_{true} - y_{pred}) 2 quadratic error (MSE). Here the loss work basically takes the average of all the quadratic errors. The superior the predictions, the lower the losses [19]. Another issue, in this case, is to strive to minimize its losses. For simplicity, we are going to consider the input values for only one foster child named Aziza.

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$$MSE = \frac{1}{1}\sum_{i=1}^{1}\left(y_{true} - y_{pred}\right)^2 = \left(y_{true} - y_{pred}\right)^2 = (1 - y_{pred})^2 \quad (2)$$

We can then write the loss as a function of many variables. L (w_1, w_2,…, w_{20}, b_1, b_2, b_3, b_4, b_5) Now we can find by $\frac{\partial L}{\partial w_1}$differentiating how to lose by changing w1 a little.

According to the rule of complex function differentiation, the following equation is valid.

$$\frac{\partial L}{\partial w_1} = \frac{\partial L}{\partial y_{pred}} * \frac{\partial y_{pred}}{\partial w_1} \quad (3)$$

$\frac{\partial L}{\partial y_{pred}}$is derived from what we calculated above, which is equal to $\frac{\partial L}{\partial y_{pred}} = \frac{\partial(1-y_{pred})^2}{y_{pred}} = -2\left(1 - y_{pred}\right)$ (4).

The output neuron o_1 and the neurons h_1, h_2, h_3, h_4 that affect it can be written using the sigmoid function f as follows.

$$y_{pred} = o_1 = f(w_{17}h_1 + w_{18}h_2 + w_{19}h_3 + w_{20}h_4 + b_5) \quad (5)$$

$$\frac{\partial y_{pred}}{\partial w_1} = \frac{\partial y_{pred}}{\partial h_1} * \frac{\partial h_1}{\partial w_1} \quad (6)$$

$$\frac{\partial y_{pred}}{\partial h_1} = w_{17} * f'(w_{17}h_1 + w_{18}h_2 + w_{19}h_3 + w_{20}h_4 + b_5) \quad (7)$$

is found in $\frac{\partial h_1}{\partial w_1}$in the same order.

$$h_1 = f(x_1w_1 + x_2w_2 + x_3w_3 + x_4w_4 + b_1) \quad (8)$$

$$\frac{\partial h_1}{\partial w_1} = x_1 * f'(x_1w_1 + x_2w_2 + x_3w_3 + x_4w_4 + b_1) \quad (9)$$

Here $f'(x)$functions are equal to the following.

$$f(x) = \frac{1}{1 + e^{-x}}$$

$$f'(x) = \frac{e^{-x}}{(1 + e^{-x})^2} = f(x) * (1 - f(x))$$

C.1.3. Evaluate neural network predictions

The FF neural network was built utilizing the Python programming language. The number of works out in network training was set at 1,000. At the same time, a windows application was developed (Figure 6). 25% (22) of the comes about of the experimental analysis were compared with the actual value for the evaluation of the FF neural network.

Figure 6. An application interface that predicts children's creative ability

The results showed that the relative error of the network tended to be stable, and the relative error was smaller, the model prediction accuracy was higher.

III. CONCLUSION

This article provides fundamental concepts within the neural network model and data about distinctive neural networks. Recurrent (Repetitive) Neural Networks (RNN) and Feedforward (Linear) Neural Networks (FF) - The ideas and key features were summarized and the FF neural network was selected as a model in this article. For PEI trainees, data almost age, gender, passion for training, and parenting were chosen as variables. The parameters selected in predicting the creative ability of the trainees were analyzed as a result of correlation test analysis: the passion for training is most influenced, taken after by factors about age and parents, and sex is less influenced.

When predicting the creative ability of PIE trainees through the FF neural network, the results showed that after the number of sessions for the FF neural network reached 1,000, their relative error model prognosis was steady and the relative error was smaller, ie, model expectation accuracy was high.

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