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Neural Network Analyses of the Romanian People working in Foreign Country's

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Abstract
Millions of people went from Romania to make a fortune in foreign countries and a few of them came back and make their life easier at home. There are some preconditions for each of them and there have some expectations of the outcome of the time spent. Because these factors are not related in a straight way, the analysis of the problem needs knowledge discovery. We choose artificial neural networks to recognize some patterns related to this problem. In neural network analyses, sometimes the results are good, but we cannot transform it in adequate conclusions. These results are fitted to predict the outcomes of *new* data. Neural networks mimic the functions of the human brain. In comparison with the fuzzy sets, the artificial neural network is the hardware, and the fuzzy set model is the software approach of, sometimes, the same problem. We have a brunch of problem, for that the neural network model cannot be substituted by the fuzzy model, although the results of the fuzzy approach are most human-readable. Our problem is maybe closer to the fuzzy system, but this time we want to verify the neural network approach. We use this analysis to discover patterns between the inputs of a human that goes outboard to work in foreign country for a period of time and the outputs of the work, like material realization, education and professional profit.

Keywords: neural networks, foreign labor, input, output

Introduction

Romania is the land from where millions of people went in foreign countries to make a fortune. But there is no free lunch in Great Britain or in Germany, or elsewhere. Our subjects were in foreign countries and come back with money or with experience, or both. We want to discover if the factors we believe to be important before travel and the results of the work like foreigners in other countries are somehow related. We discover that is no correlation between two of the data columns combined. This makes us to consider the neural network analysis able to solve this cumbersome problem. We choose six factors for input and five for the outputs that results from the implementation of the questionnaire through the subjects returned in Romania. The six factors for the inputs are composed by the following expectations: *material*, *connection network building*, *self-actualization, professional* and the jobs related factors: *activity before the foreign work*, *the foreign job*. The five target factors are: *the material realization*, *the social network construction*, *self-actualization, professional advancement* and the *activity after returning in the country*. Our conclusion is that not all targets can model with a simple neural network using the inputs choose. Because we have six input arguments, we choose from one to six hidden neurons to solve the fitting expectations. It is enough to draw some conclusions. This paper evolves during some sections. In the next section we address the basis of the research: the *people* and the *data*. The research is based on a PhD thesis entitled: "*The Economical and Social Characteristics of Foreign Labor in Harghita County"* and a Domus research fellowship: "*Working abroad in the years following the economic crisis in Harghita County",* accepted and financed by the Hungarian Academy of Sciences, from where we get the responses regarding the people involved from our region, the main problem researched, the factors and facts questionned. In the third section we show the method and the framework used to analyze a part of the research data with the factors mentioned. The fourth section shows the results of analyze, concluded in the last section. [4], [5]

Material and Methods

For the *quantitative* research as a sampling technique, Péter have chosen the snowball sampling method because she only had a few data about the population used by Tomcsányi. Thus she has started with two interviewee chosen based on their activity before foreign labor (workers from industry and agriculture). The interviews were taken in the November-December 2012 period. In her questionnaire she has used both, open and closed questions. [4], [6]

During the process she has contacted 85 people, 53 answered. Invoking personal reasons failure, shame, inconveniences in adapting 32 people refused to answer. She experienced refusal in taking part in the process, but only few cases when a person did not want to answer a certain question.

She contacted people from the analyzed county, who returned in Romania and are older than 18. The questionnaire based on analysis shows that the repetitive character of emigration is in a significant correlation with the activity undertaken before emigration. 29% of unemployed, 19.4% of intellectual workers, 19.4% of those working in industry, 12.9% of students and 12.9% of newly graduates undertook repeatedly the difficulties of foreign employment. 35.5% of those who repeated emigration did not find a job after returning home, 22.6% was hired in an intellectual profession, 3.2% worked in commerce and services and 6.5% continued their studies. 41.9% of the women and 58.1% men are repeated emigration and the number of family members did not significantly influence the decision of repeating the foreign experience.

An interesting observation is that public servants, considered to have a solid function, also decided to leave, and young university graduates try to find their first job abroad. Analyzing the results of the research we can conclude that after undertaking a job abroad, more and more become unemployed and continue their unfinished studies. Agricultural and industrial activities are not attractive for those returning home. People are interested to work in services. The research shows a significant decrease in entrepreneurship. None of the interviewees launched their own business. One person declared that he bought equipment for his carpentry, but does not plan to establish a firm; now he is doing some “black work” for his family and acquaintances. Based on the results of the research we can conclude that financial expectations at the beginning of employment are significantly correlated to the field of activity undertaken during working abroad. In the post crisis years, the repayment of bank loans contracted in incautious conditions represents a serious problem. The indebtedness influenced not only unemployed, but also underpaid young graduates and white-collar workers to undertake jobs abroad.

Literature review

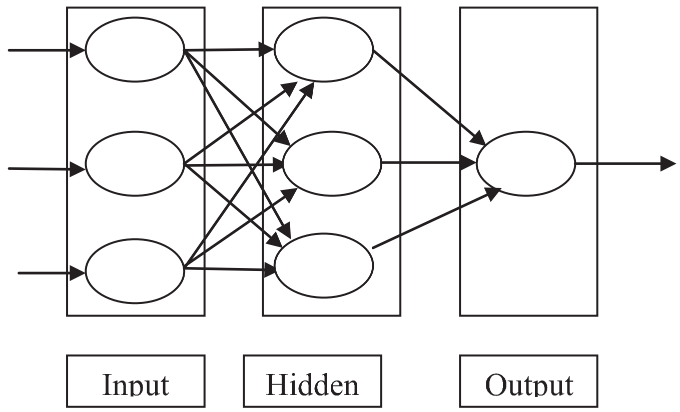
The Neural Networks

In 1948, Alan Turing proposed the concept of neural network in his paper *Intelligent Machinery* and he named them "B-type unorganized machines"[8]. There are some steps and some dead periods in the evolution of the concepts and applications of the model. Computer storage and operational memory are two main factors that influenced the use of the network in applications. One big step was the definition of the concept of perceptron, by Rosenblatt. [7]

The other big change was proposed by Hopfield and the name of his network became Hopfield network. In opposition of Neumann's computer model, in the Neural Network model the memory is not separated from the algorithms, and this model uses parallel computing for problem solving. We refer with the Neural Network term to Artificial Neural Networks. [2]

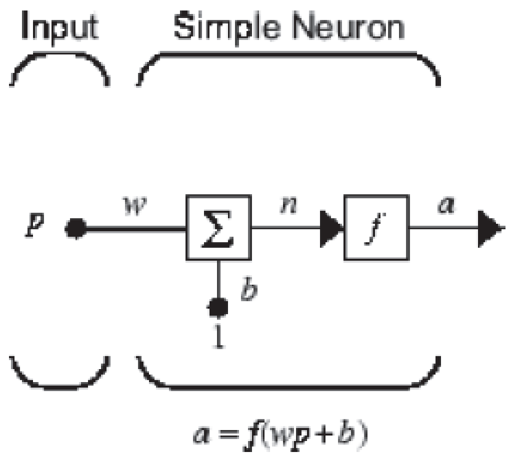
Like brain is capable to learn, artificial brain or artificial neuron networks are capable to machine learning and pattern recognitions. Neural networks are constructed with two components: the neuron and the linkage between neurons. These linkages are called synapses and the model an output from a neuron and an input for one or more neurons. Every neuron has a weight in the network. This weight determines the *importance* of a neuron in the neuron chain, in a problem solution. This weight is between 0 and 1. There are some constant values called *biases* that characterize one layer or one perceptron. [1]

Fig. no. 1. Feed forward simple artificial neural network



We present only that part of neural networks that we use for our modeling problem. The input layer has *n* neurons, that represents the number of factors we consider inputs in our system. The output layer consists of *1* to *m* neurons, depending how many outcomes are in the model. In our approach we analyze once all the five output targets together. Our analyses continue with the analyses of each output target in separate networks. Without a hidden layer, we do not solve sophisticated problems. Because our goal is to obtain a hidden layer with small number of neurons, we take into consideration the hidden layer from *1* to *n* neurons. The maximum number of hidden neurons is the number of input factors. Every neuron has a *weight* an *activation function and an optional bias*. The activation function is triggered by the "sum" of the input factors. The activation function "transmits" the information in the network across one neuron, if the neuron has enough inputs triggered with enough weights and bias value.

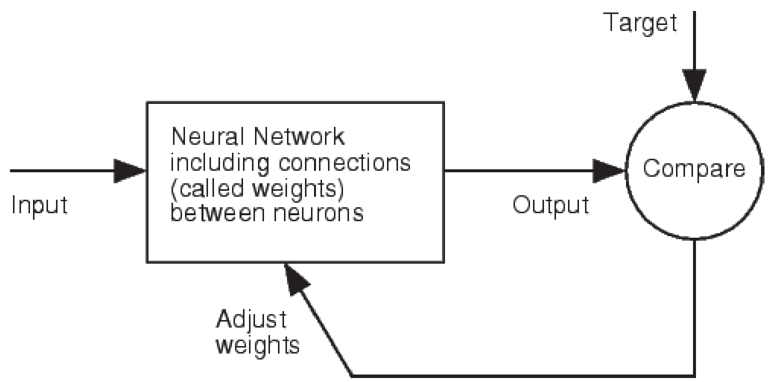
Fig. no. 2. Simple neuron



We can see in figure no. 2 the mathematical model of a simple neuron, the factors: *weight* (w), *bias* (b), *input* (p), *activation function* (f) and the *output* (a). If we have other inputs involved, the output transforms to: $a = f(\sum_{i=1}^{n} w_i p_i + b_i)$, where n is the number of inputs for the neuron.

To solve a problem, we have to train the network. This train may consist in (1) modifying the *weights* of the neurons, (2) modifying the *bias* values, (3) modifying the *number* of hidden neurons, (4) modifying the *structure* of the hidden layer. We use supervised learning. Supervised learning is presented in figure no. 2, and we obtain that from the Matlab™ documentation.

Fig. no. 3. Supervised learning (from Matlab™ documentation)



When we use supervised learning, we have prior knowledge about the problem or the domain. On supervised learning we have targets and outputs that are compared. If the mean-squared error is greater than an accepted error, we have to adjust the weights of the neurons. The most common learning method is the back-propagation algorithm.

Results

Our main goal is to discover the *minimal size* of hidden neuron layer to model our problem. We want to discover what output factors have the model, with minimal hidden neurons. The tool we used gives us minimal information about the solution, the structure and the parameters. Because this, we use this tool to observe the factors that are in closer relation with the inputs. If we have many neurons in the hidden layer, the problem gets out of human understanding and becomes an engineering solution, rather than a scientific approach.

We use the Neural Network Toolbox™ in Matlab™. We train a neural network to fit a function (nftool). We use feed-forward network with the default tan-sigmoid transfer function in the hidden layer and linear transfer function in the output layer. We train using the default algorithm: Levenberg-Marquardt back-propagation (trainlm).

First, the input layer has 6 neurons, the hidden layer from 1 to 6 and the output layer 5 neurons, because we want to solve the whole problem with one neuron network. We find a good solution with 2 neurons and a better solution with 6 neurons in hidden layer. We present the 2 neuron's result because we consider it to be better in the perspective of the dimension of the hidden layer. We train and retrain the network in every case, 20 times.

And the question arises: why has better solution a network with 2 neurons than one with 5 neurons? Because the complexity of the problem and the type of solution. This solution is a gradient type solution, and when we add a new neuron, we add a new dimension to the problem, involving exponentially growing of the solution space.

The "Regression R Values measure the correlation between outputs and targets. An R value of 1 means a close relationship, 0 a random relationship."(Matlab^{TM}) In figure no. 4 we have a good solution for 2 neurons in hidden layer.

Fig. no. 4. Regression diagrams for hidden layer with 2 neurons and 5 outputs

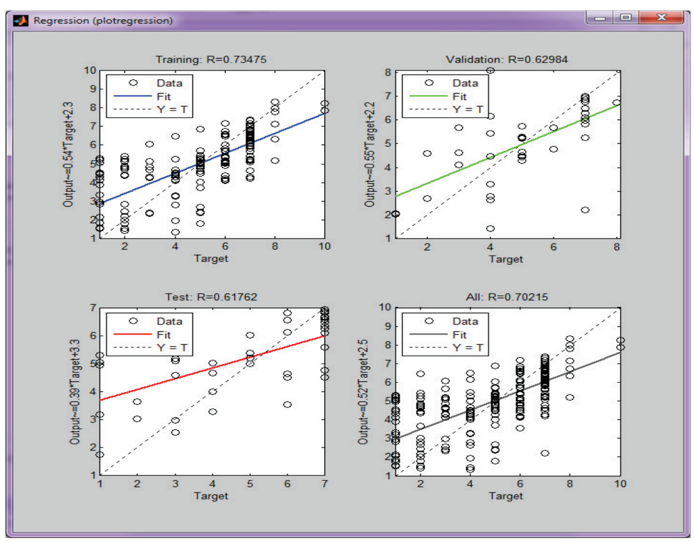
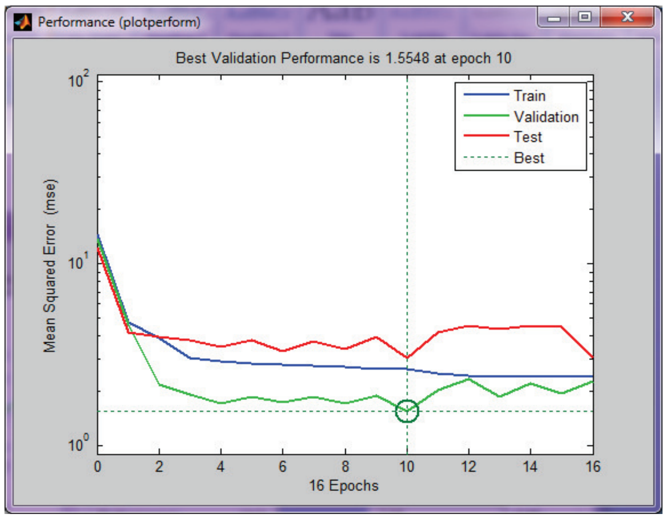


Fig. no. 5. Performance diagram for hidden layer with 2 neurons and 5 outputs



"Mean Squared Error is the average squared difference between outputs and targets. Lower values are better. Zero means no error."(Matlab™) The best validation performance is good also.

Fig. no. 6. Regression diagrams for hidden layer with 3 neurons and material realization output

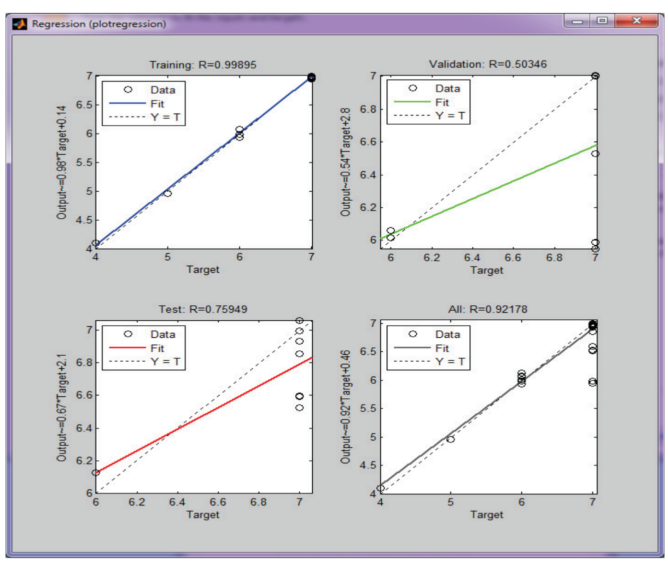
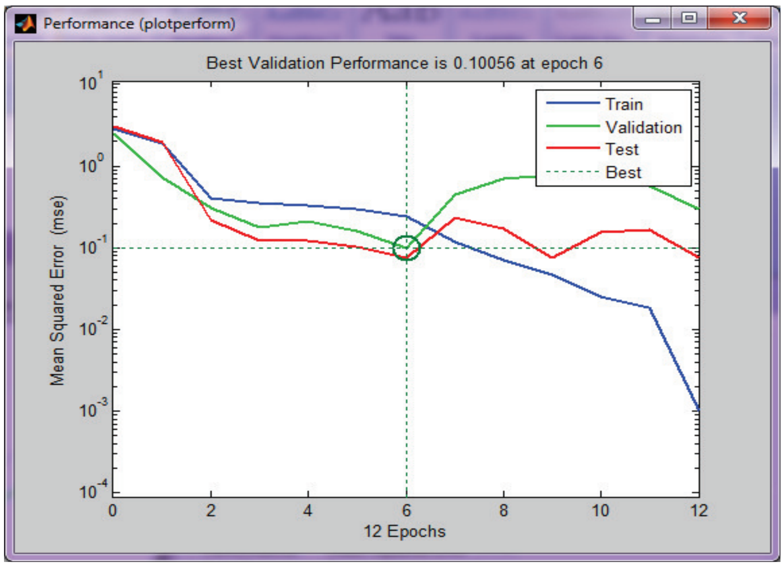


Fig. no. 7. Performance diagram for hidden layer with 3 neurons and material realization output



After analyzing the five outputs separately with hidden layers with 1 to 6 neurons, our result is that the most correlated output with the inputs is the *material realization*. We show the diagrams for this parameter in figures 6 and 7. The next is the professional advancement, and we show the descended order of correlation in table 1. It is interesting to see that the activity after returning home is the worst correlated parameter. This is, maybe because the people, after good material satisfaction, don't appreciate the jobs with low wages at home.

Table 1 - The ranking order of correlation outputs

Nr.	Output target name
1.	Material realization
2.	Professional advancement
3.	Self actualization
4.	Social and professional network construction
5.	Activity after return

Conclusion and future work

We assumed that if we have few neurons in hidden layer and the Neural Network performs well, the output factor has a stronger relationship with the input factors than otherwise. We discover that the *material expectation* factor is correlated better than others. We give the order of the correlated parameters. Because we used proprietary software, these results can help us to build our own network with free software components. We want to do this and to combine with evolutionary methods, the training of the network. Other approach could be the fuzzy approach, where we can find the rules even if our knowledge of the system is poor, by evolving the rules and give weights of the factors in the rules.

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