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OVERVIEW OF NEURAL NETWORKS FOR FORECASTING

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Introduction. Spring wheat, which is considered the most valuable food crop among grain crops, is one of the most demanding crops in terms of growing conditions. For a more efficient organization of sowing, knowledge of the degree of influence of the fractional composition of humus on productivity can have a positive effect. To determine the influence of the fractional composition of humus, you can use the usual mathematical, statistical methods, algorithms and models, but they do not have a high level of reliability and efficiency ratio [1]. Therefore, this task can easily be accomplished by an artificial neural network that helps the agronomist, based on a wealth of data, to identify hidden patterns and highlight the most relevant factors.

Currently, the difficulty of forecasting is that agronomist subjectively evaluates the influence of different factors on yields based only on his knowledge and experience, while neural networks can find algorithms with a lot of information that are often impossible for agronomists to detect.

This calls for a detailed study of the development of a neural network model to predict the influence of humus fractional composition on spring wheat yields. In this article, we aim to review existing neural networks for forecasting in order to further develop a neural network model to predict the influence of humus fractional composition on wheat yield.

Methodology. In order to achieve this objective, neural networks for forecasting will be considered, neural networks will be classified according to classification characteristics, which will define the characteristics of the future neural network in order to predict the influence of humus fractional composition on wheat yields.

After analyzing and comparing traditional methods and the use of neural networks in forecasting, we can see the following differences between these methods.

Traditional forecasting methods are first based on data that were previously available during observations. They find the model and extrapolate the values of the variable to the future. This estimated value is used as a forecast, and further actions will be performed based on this value. There is an assumption from the beginning that the future will be exactly like the past.

As for artificial neural networks, past experience is studied first, patterns and relationships between parameters are determined. This is called learning. This property of neural networks is one of the advantages over traditional forecasting methods.

Another advantage is adaptability, calculations by the traditional method need to be carried out again, if there is a change in the study area.

Neural networks can also learn when some data is missing or when there is incomplete or distorted data.

But despite a number of advantages, neural networks also have disadvantages: for a high-quality forecast, it is necessary to prepare a very large amount of normalized data. Sometimes it is not possible to collect such data.

It is also worth noting that both neural networks and traditional prediction methods look for values that can predict the dependent variable. But the neural network benefits from the fact that there is no need to bind the quantities in advance.

Some scientists (A.A. Yezhov, S.A. Shumsky) in their work [2] argue that neural networks and traditional methods are used either in the same or similar areas. They note that neural networks are fairly universal. The authors also compare neural networks with well-known and widely used methods of statistics, as they are used in the fields of data analysis. The statistics books say that the common approaches of neural networks are inefficient regression and discriminant models. Regression and classification problems can be solved by neural networks with multiple layers. It should be noted that neural networks are more diverse in processing data (Hopfield networks or Kohonen maps). The advantages of using neural networks over using old statistical methods are also reflected in many business and financial research.

In time series prediction, most neural network training algorithms have an action sequence [3-6] as shown in the flowchart in Figure 1.

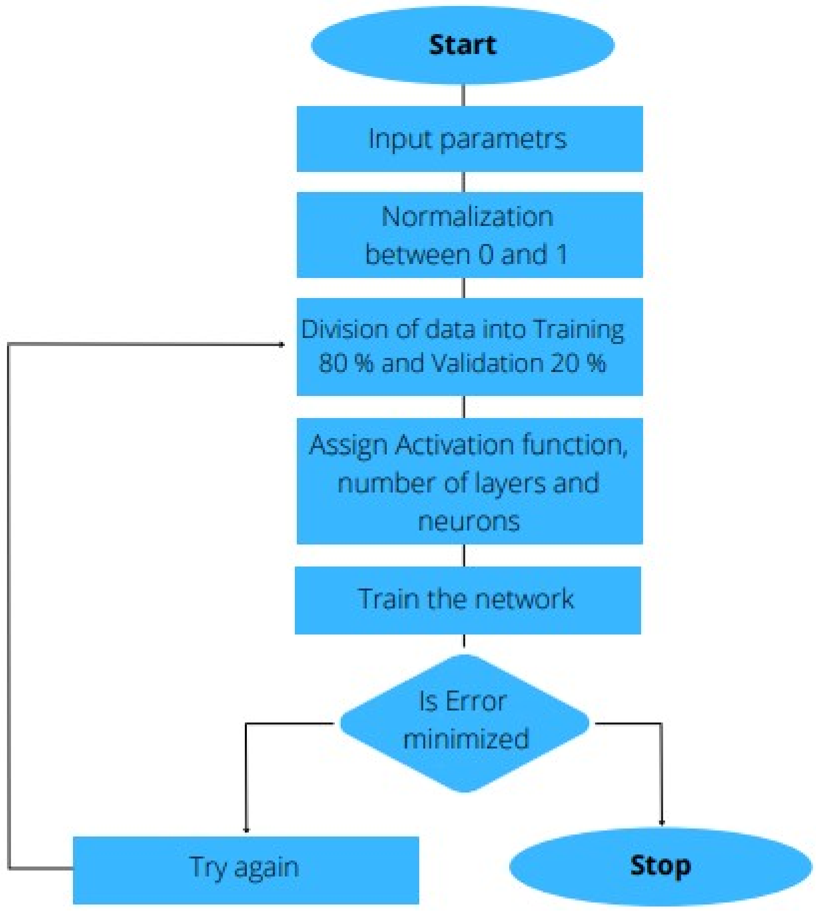

Figure 1 – An action sequence in training

The architecture of an artificial neural network consists of input layers, hidden layers and output layers. Neurons in one layer have no connection to each other. Signals from one level are transmitted to the next level via a non-linear transmission function. The problem with using a multilayer perceptron (MLP) algorithm is to obtain an optimal model. However, this can be solved by using various variants of the MLP algorithm to obtain an effective model.

A recurrent neural network (RNN) is a type of artificial neural network that is well suited to solving time series problems. The difference between the time series and the regression prediction model is that they increase the influence of the input variables on the sequence. Neural networks such as recurrent neural networks are used to process sequences. The long-term short-memory network or LSTM network is a type of recursive neural network that is often used in deep learning.

Convolutional neural networks can be extremely effective in solving problems similar to image classification, but they are also effective in working with sequences. In these neural networks, the filter is shifted over the time series, receiving a weighted sum and applying an activation function to it. Convolutional neural networks do not have memory, however, when composing many layers, the upper layers appear to see most of the sequence, so convolutional neural networks can cover long-term patterns. Neural networks can be classified according to the direction of distribution of information over synapses between neurons: feed-forward neural networks, recurrent neural networks, radial basis functions, and self-organizing maps.

Feed-forward neural networks (unidirectional). In this structure, the signal moves strictly in the direction from the input layer to the output layer. The signal does not move backwards and is not possible in principle. Today, the development of this plan is widespread and has successfully solved the problems of pattern recognition, prediction and clustering.

Recurrent neural networks (with feedback). Here the signal moves forward and backward. As a result, the exit result is able to return to the entrance. The output of the neuron is determined by the weight characteristics and input signals, plus supplemented by previous outputs that return to the input. These neuronetworks have a function of short-term memory, which allows the signals to be restored and supplemented during processing.

But these are not all sorts of classifications and types of neural networks. According to Figure 2 they are also divided [8]:

- Depending on the types of neurons: homogeneous, hybrid.
- Depending on the method of neural networks for learning: learning with a teacher; without a teacher; with reinforcements.
- According to the type of input information, neural networks are: analog; binary; figurative.
- According to the nature of the synapse settings: with fixed connections; with dynamic links.

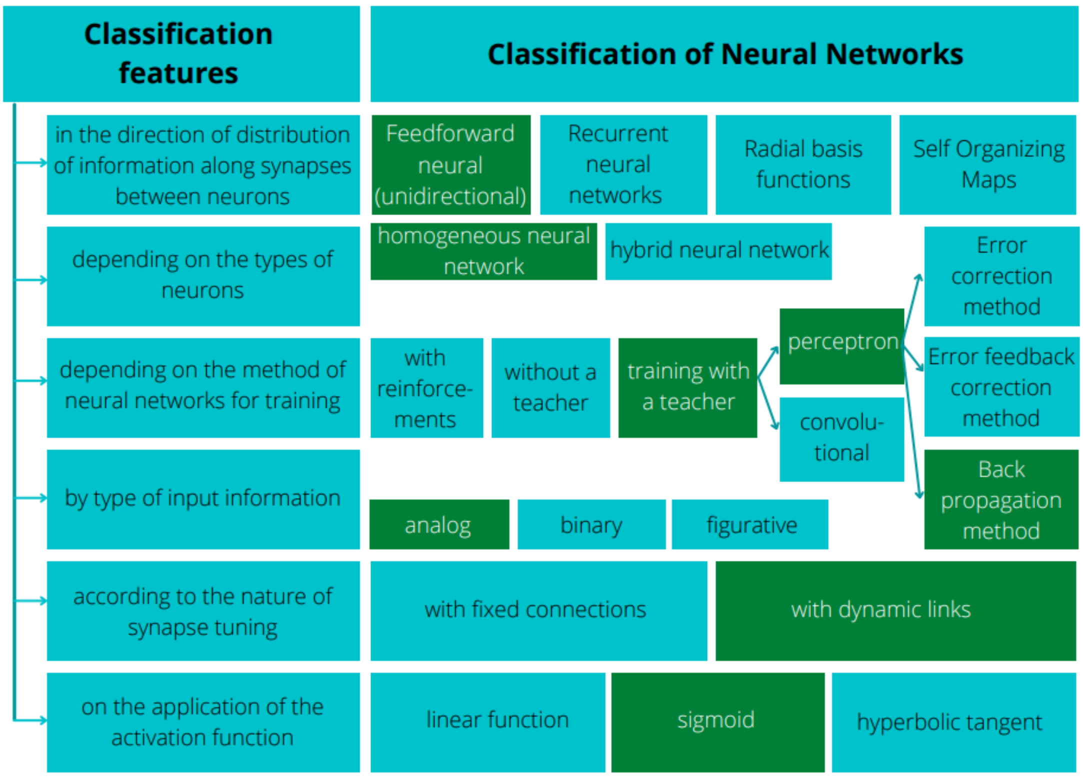

Figure 2 – Neural network classification

Conclusion. Finally, we found out how to classify neural networks by classification features, and also looked at the neural networks used in prediction. The following characteristics were selected from the neural network classification system for the development of a neural prediction network: a unidirectional homogeneous neural network that will be taught by teacher with error backpropagation method, and in which the sigmoidal function of activation will be applied. Further research should focus on the construction of a neural network model to predict the influence of humus fractional composition on spring wheat yields.

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