

CREATING AN INTELLECTUAL CHAT BOT ON THE BASIS OF A RECURRENT NEURAL NETWORK WITH SPEECH RECOGNITION

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Based on the generally accepted definition of artificial neural network - a mathematical model, as well as its software or hardware implementation, built on the principle of organization and functioning of biological neural networks - networks of nerve cells of a living organism. INS is a system of interconnected and interconnected simple processors (artificial neurons). Such processors are usually quite simple (especially compared to processors used in personal computers). Each processor of such a network only deals with signals that it receives from time to time, and signals that it periodically sends to other processors. And, nevertheless, being connected to a fairly large network with controlled interaction, such individually simple processors together can perform quite complex tasks.

There are actual data processing problems, when solving which we encounter not individual objects, but their sequences, i.e. the order of objects plays a significant role in the task. For example, this is a speech recognition task, where we are dealing with sequences of sounds, or some natural-text processing tasks, where we are dealing with sequences of words.

To solve such problems, you can use recurrent neural networks, which in the process can save information about their previous states.

Unlike a regular direct distribution network, the input image of a recurrent network is not one vector, but a sequence of vectors  $\{x_1, x_2, \dots, x_n\}$   $\{x_1, x_2, \dots, x_n\}$  the vectors of the input image in a given order are fed to the input, while the new state of the hidden layer depends on its previous states.

$$\begin{aligned}h(t) &= f(V \cdot x(t) + U \cdot h(t-1) + bh) \\y(t) &= g(W \cdot h(t) + by),\end{aligned}\tag{1}$$

where  $x(t)$  – input vector number  $t$ ,  $h(t)$  – state of the hidden layer to enter  $x(t)$ ,  $h(0)=0$ ,  $y(t)$  – network output  $x(t)$ ,  $U$  – distribution weight matrix,  $W$  – weight (square) matrix of feedbacks of the hidden layer,  $bh$  – lateral layer shift vector,  $V$  – output weight matrix,  $by$  – output shift vector,  $f$  – hidden layer activation function,  $g$  – output layer activation function.

The input signal vector is fed to the INPUT group of neurons, the zero signal on the CONTEXT neuron group. Further, the signal propagates into the group of neurons of the hidden layer HIDDEN, and then is transformed by them and hits the neurons of the output layer OUTPUT. At the next iteration, along with the INPUT signal vector, copies of the signals from the output OUTPUT layer of the previous iteration are sent to the context group of neurons.

The structure of the recurrent neural network for memorizing sentences is as follows:

The CONTEXT, INPUT and OUTPUT layers each have one neuron, the signal values at the output of which correspond to the index of a word in a set of words. Additionally, the word \_\_end\_\_ is entered corresponding to the end of the sentence. The volume of HIDDEN layers should allow you to memorize the entire set of sentences. The network is consistently trained in the following sentences:

«Привет. Как дела? \_\_end\_\_ Привет. Нормально. \_\_end\_\_»

The property of the statistical communication of questions and answers in the knowledge base and the choice of the corresponding answer from the knowledge base to the user on the question can be realized on the basis of the following algorithm. All questions in the knowledge base will be denoted by the word patterns.

1) their corresponding answers in the knowledge base word templates;  
2) each question and the corresponding answer is divided into an array of words: pwords and twords;

3) the correlation between the unique words is calculated: If the word tword is found in the array of words twords together with the word pword in the array of words pwords, then the correlation function between the words tword and pword is added 1:  $R(\text{tword}, \text{pword}) + = 1$ ;

4) a new user question denoted by the word question;

5) the user-defined question is divided into words qwords;

6) an overview of templates responses from the knowledge base is carried out in order to find the maximum amount of correlations between the words from the response of twords and the words of the user's qwords.

In the process of learning the neural network, a learning approach with a teacher was used. To do this, each (discrete) time step sends data to the input nodes, and other nodes complete their activation, and the output data is prepared for transmission to the next level of neurons. That is, in our case, recognized words arrive at the output nodes. As a training sample was collected corpus frequently asked questions of applicants for the last introductory campaign at NAU "KhAI". The network is trained in the back propagation method.

Using the simple selection method, the most satisfactory result was shown by a neural network with five HIDDEN layers of 700 neurons each.

Using the module of the morphological analyzer of individual words and bringing them into the base form allows you to improve the quality of the search for relevant responses. The recurrent neural network allows you to get answers to questions that were not in the knowledge base, through the ability of the network to generalize.

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