Development of a method for determining the state of a person using a chat bot

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Abstract. The aim of this work is to develop a method for determining the state of a person using a chat bot. The existing solutions were analyzed, their shortcomings were identified in order to create a more optimal solution. The proposed method is based on the creation of a chat bot on a neural network. The article presents the types of neural networks with a description of the principles of operation, discusses the possibilities of programming languages for solving the task, and also provides a rationale for the chosen programming language - Python, presents the architecture of a neural network in this language. Since the most important and difficult task when working with a neural network is its training, the article describes this process with a description of each stage of training. Also, the interface of the developed application is presented with an example of the pictures used by the chatbot.

1. Introduction

In the modern world, all spheres of life are associated with the introduction of information technology and automation of work processes. Enterprises that do not adhere to modern trends are doomed to a complete loss of interest in their activities. Therefore, they need to develop. One of the potential directions of such development is the introduction of intelligent systems that help in work, for example, a chat bot as an electronic assistant or consultant in various activities.

Chatbot is a virtual interlocutor robot program. These programs are most often used in business or entertainment as "consultants" helping to quickly find the information a person needs.

The authors offer a description of a chatbot that recognizes the text of a message, determines its emotion and, as well as the selection of a suitable message and picture as a response. The proposed solution is quite universal, as it can be in demand and relevant in completely different areas of activity. The relevance of the topic is confirmed not only by the demand for this technology, but also by the versatility of the proposed solution. For example, in the case of little experience of specialists working with sowing, it may be necessary to define a request for the provision of images or data to a particular culture (to determine the type of culture by colloquial, "philistine" description). This technique is useful for helping budding farmers develop their farms, allowing them to quickly find the information they need.

The authors studied the main methods of automatic sentiment determination: using dictionaries or based on neural networks [1,9]. Neural networks make it possible to process nonlinear control algorithms with insufficient, inaccurate description of the object (or even in the absence of a
description), create a stable system with unstable parameters. Given this information, as well as the fact that an important criterion for the developed bot is learning, the most suitable method is to use a neural network. In addition, it can be noted that the formation of a comfortable dialogue for the interlocutor is possible in the case when the following requirements are presented to the interlocutor-robot: chat bots must use natural language, must be emotionally literate, must be able to analyze, and must also be user-oriented. To implement all the requirements, the best option is to use a neural network.

2. Materials and methods

Neural networks are most often divided into ordinary and convolutional. In a conventional neural network, all nodes, except for the input and output, are both input and output, forming a hidden layer of neurons, where the neuron of the next layer is connected to all neurons of the previous one. The inputs are presented with weights, which are adjusted during training and are not changed further. Also, each neuron has a border, after passing which it takes one of the possible values: -1 or 1, or 0 or 1 [1, 2].

The convolutional neural network architecture allows for the most efficient pattern recognition. The convolutional layers alternate and the structure is unidirectional. Each element of the image is multiplied by the convolution kernel element by element, and the result obtained is summed up and stored in a similar position in the output image [6]. Such a structure provides a variety of recognition with respect to the displacement of the object, gradually enlarging the "window" at which the convolution "looks", revealing larger patterns in the image.

One of the main areas of machine learning is Deep Learning, which includes two factors: nonlinear processing in multiple layers and supervised learning or without it [1, 11]. Nonlinear processing from multiple layers is represented by an algorithm in which the current layer takes as input the output of the previous layer.

There are many programming languages for implementing neural networks. Despite the fact that a neural network can be created in any Turing complete programming language, the main language used for these tasks is the Python programming language [7, 8]. The main advantage of Python is a large number of libraries, documentation, and the ability to create programs even without deep programming knowledge. Python has a set of pre-configured tools for implementing models and machine learning algorithms. This allows programmers to use Python to implement machine learning and build, for example, chatbots from scratch. The Scikit-Learn library allows for such capabilities, since it provides a large number of machine learning algorithms. You can also note the ChatterBot library, designed for speech processing and training on datasets in the dialog format [3, 5].

However, there may be situations where machine learning needs to use a lower level language. As a rule, in such cases the C++ language is used. The Python language is interoperable with C++. Thus,
the Python language is the most optimal and universal language for writing a trainable chatbot based on a neural network.

The architecture of a neural network in Python is based on a mathematical model of information recognition by the brain, which includes sensors, associative and responsive elements. This architecture is depicted in Figure 1.

3. Results
To train a chatbot based on a neural network, the following steps are required:

- data preprocessing;
- vector display of words and texts;
- training.

During preprocessing, the data is brought to a specific, unified format suitable for further work with it. For example, all words are cased, references are replaced, and punctuation is removed.

At the stage of vector mapping, the semantic meaning of words is mapped into vector space. This approach is based on locality hypotheses - if words are in the same environment, then the meanings of such words are similar. Thus, the method is based on the assumption that the word will appear in a certain context. As a result of this stage, sets of vectors are obtained, the values of which correspond to the semantic meaning of each word.

In the general case, training a neural network is reduced to minimizing the error function by adjusting the weight coefficients of synaptic connections between neurons. In the model, words are associated with unique vectors that change in the process of training the model. The resulting model is able to determine some of the semantic properties of words. [2,12].

Thus, the neural network must recognize the text, determine the emotion in the text and select the necessary picture. If, for a start, we compare the picture with certain words, then train the network, it will have to produce a picture in those cases when it fits the context. That is, you can teach the network to give a smile, for example, with a greeting or a "positive" word, or a sad picture, respectively. If you develop this method, then you can teach the neural network to find the necessary pictures from the base to provide answers to questions on a given topic [4].

Recurrent neural network is capable of storing, generalizing and predicting various sequences. Therefore, to simulate human communication and train a chatbot, it is necessary to use a recurrent neural network. The bottom line is that the neural network is given the task to predict the next word based on the n-previous ones. Output words are encoded according to the principle of one output neuron - one word. Input words can be encoded in the same way or use a distributed representation of words in vector space, where words that are close in meaning are at a shorter distance than words with different meanings.

A recurrent neural network capable of storing, generalizing, and predicting various sequences. Therefore, to simulate human communication and train a chatbot, it is necessary to use a recurrent neural network. The bottom line is that the neural network is given the task to predict the next word based on the n-previous ones. Output words are encoded according to the principle of one output neuron - one word. Input words can be coded in the same way, or you can use a distributed representation of words in vector space, where words with similar meaning are at a shorter distance than words with different meanings.

Chatbot creation consists of the following main parts:
1. Registration of the bot in the messenger;
2. Creation of a web service that accepts requests and generates responses;
3. Creation of logic for working with teams;
4. Working with the database

A recurrent neural network can store, generalize, and predict various sequences.

One of the markup formats of the knowledge base is the AIML (Artificial Intelligence Markup Language) markup language standard. The keywords in the language are category, pattern and template:
A recurrent neural network is a type of multilayer perceptron in which signals from neurons in the output layer are fed to additional neurons in the input layer, the so-called context neurons.

The input signal vector arrives at the INPUT group of neurons, and a zero signal at the CONTEXT group of neurons. Then the signal propagates to the group of neurons of the hidden layer HIDDEN, and then is transformed by them and gets to the neurons of the output layer OUTPUT. At the next iteration, together with the INPUT signal vector, copies of signals from the OUTPUT output layer of the previous iteration are sent to the contextual group of neurons (Fig. 2).

Figure 2. General view of the structure of a recurrent neural network.

The CONTEXT, INPUT and OUTPUT layers each have one neuron, the signal values at the output of which are assigned to the word index in the word set. Additionally, the word __end__ is introduced corresponding to the end of the sentence. The network is sequentially learning sentences of the form:

"Hi. How are you? __end__ Hello, fine. __end__"

Receiving answers to questions by a recurrent neural network occurs according to the following scheme (Fig. 3).

Figure 3. Getting an answer to a question by a recurrent neural network.
The volume of the HIDDEN layers should allow memorizing the entire set of sentences. The network is trained using the backpropagation method.

At the current stage, a chat bot interface has been developed, which consists of a message input field, a dialogue display field and a chat bot emotion image display field. The interface is shown in Figure 4.

![Chatbot interface](image)

**Figure 4.** Chatbot interface.

An example of the emotions used by the chatbot can be seen in Figure 5.

![Chatbot emotions](image)

**Figure 5.** An example of chatbot emotions.

4. Conclusion
In this article the authors show the relevance and versatility of creating a chat bot that recognizes emotions. The substantiation of the choice of methods and programming language is given. It has been determined that the use of neural networks is quite diverse, they are trainable, and this allows you to optimize and maximize the efficiency of their use.

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