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APPROACH FOR USING NEURAL NETWORK BERT-GPT2 DUAL TRANSFORMER ARCHITECTURE FOR DETECTING PERSONS DEPRESSIVE STATE

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Abstract. *The paper proposed the method of using neural network BERT-GPT2 dual transformer architecture for detecting persons depressive state designed to transform input data in the form of text and trained neural network BERT-GPT2 dual transformer architecture model into output data in the form of the numerical assessment of the presence of persons depressive state. Experiments were conducted with the use of the given developed software complex for detecting persons depressive state, which testify to the correctness of the proposed approach. From the performed performance study, the dual architecture did not make a single error during classification.*

Introduction and problem statement. The problem of intelligent detection of depressive state in text data is directly related to the ability of modern natural language processing systems to recognize subtle emotional and mental states in texts, and therefore is extremely important from point of view of information technology [1, 2]. The conditions of today's digital environment, where huge amounts of data are generated daily through social networks, forums and platforms, require effective tools to analyze and identify potential mental disorders such as depression [3].

Taking into account the increase in the duration of online communication, the intelligent detection of a depressive state in text data is an actual direction of IT [4],

and the early diagnosis and treatment of depression contribute to the improvement of the quality of life and prevent further complications [5]. Today, depression is a well-known problem that has attracted the attention of scientists because it can reduce productivity and lead to suicidal thoughts. Recently, scientists have been using machine learning and NLP to predict signs of depression, showing high accuracy.

The paper aim is to create the method of using neural network BERT-GPT2 dual transformer architecture for detecting persons depressive state, which differs from analogues in that it combines a two-stream architecture, which is based on the use of two parallel BERT and GPT2 neural networks, each of which specializes in the analysis of different aspects of the text: syntactic and semantic.

Approach. Method of using neural network BERT-GPT2 dual transformer architecture for detecting persons depressive state is intended to automate the process of identifying a depressive state based on the texts of participants in the educational process. The proposed method of creating a two-stream structure is based on the use of two parallel neural networks, each of which specializes in the analysis of different aspects of the text – syntactic and semantic. The stream of syntactic analysis is aimed at identifying the syntactic structure of the text, and the stream of semantic analysis is aimed at understanding the content and context of the text [6]. After processing the text by each stream, the results are combined at the level of a higher layer, which allows taking into account both the details of the language structure and the general content of the text for a more accurate definition of a depressive state.

The input data is a neural network model of dual transformer architecture, consisting of a combination of BERT and GPT2 models, which are designed to analyze the syntactic and semantic context of the text being used. The BERT model is used as a model for the syntactic analysis of the used text, and the GPT2 model is used for the semantic analysis.

The first step of method of using neural network BERT-GPT2 dual transformer architecture for detecting persons depressive state is to tokenize the used text with the appropriate tokenizers of the BERT and GPT2 models. The next step is the analysis of the tokenized text by BERT and GPT2 neural networks, which takes place in parallel. The BERT model analyzes the text from the point of view of syntactic dependencies, and GPT2 - semantic ones. The third step is to combine the results of both streams using a specialized fusion layer. As a result, a numerical assessment of the manifestation of a depressive state will be obtained. The initial data step of method of using neural network BERT-GPT2 dual transformer architecture is a numerical assessment of the manifestation of a depressive state in the used text.

Scheme of formation and training of neural network BERT-GPT2 dual transformer architecture is shown in Fig. 1.

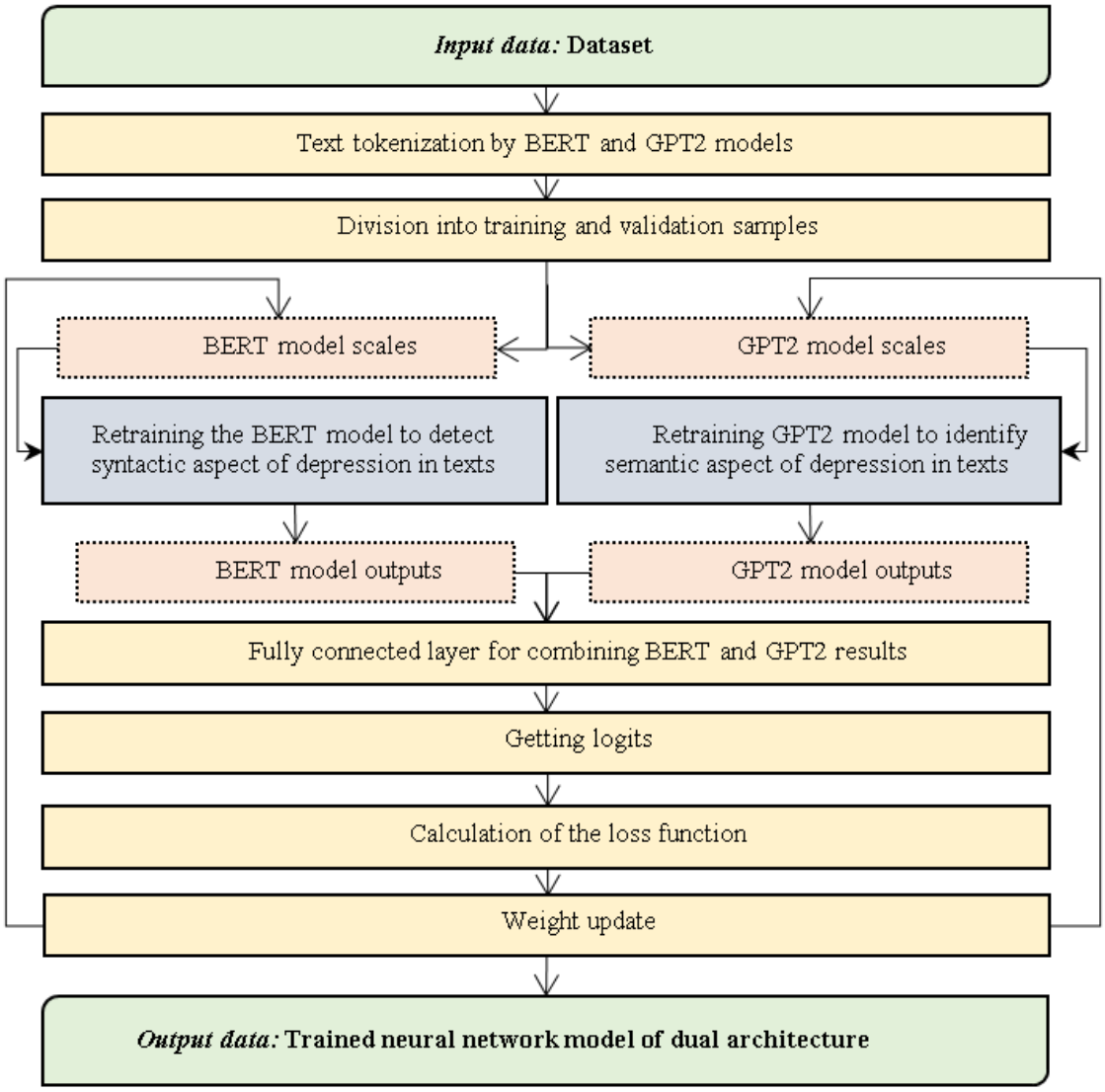

Fig. 1. **Scheme of formation and training of neural network BERT-GPT2 dual transformer architecture**

The input data is a dataset containing 2 classes – texts containing manifestations of depression associated with studying in educational institutions, and texts without manifestations of depression. The set "Student-Depression-Text" will be used, containing information in "Excel" format, which includes about 7489 data from social networks, "Facebook" comments, etc. The dataset is an annotated English-language dataset collected from people who speak very good English and are students, age range 15 to 17 [7]. The dataset contains text, label, age, age category and gender. The text columns contain the text "Normal" and "depression",

and the label column indicates whether the corresponding text represents anxiety or depression.

First, all the texts of the dataset are tokenized. Tokenization is done by BERT and GPT2 models. Further, the tokenized texts are transformed into a training sample, divided into 10% validation data and 90% training data.

Tokenized texts are fed to the input of pre-trained BERT and GPT2 models for their retraining. These models work in parallel, and after receiving outputs in the form of vectors, they are combined in a fully connected layer. This layer processes the concatenated vector, producing a final vector of logits, which is then used to calculate the loss function and predict the results.

According to the results of the loss function, the weights of the neural networks are updated by performing a reverse pass in the direction of reducing the error.

Practical implementation and results. To investigate the effectiveness of the proposed method, a software complex was developed, consisting of a laptop implemented in the cloud environment "Google Colab" for training a neural network and a web interface that uses a trained neural network model of dual architecture. The web interface is implemented using the "PyCharm" programming environment and using the "Flask" microframework.

The neural network was trained for 2 epochs due to the lack of computing power (more than 40 GB of RAM is required). However, the results of the study indicate the sufficiency of the epochs spent. To conduct experiments with the trained model, a web interface was created, an example of its use is shown in Fig. 2.

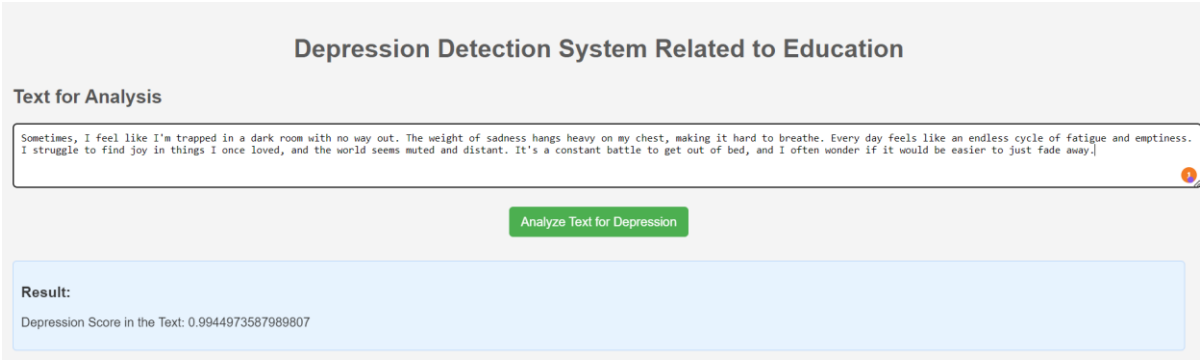

Fig. 2. **Software web interface for detecting persons depressive state**

As experiment, comparison of transformer architectures GPT-2, BERT and the developed neural network model of dual architecture will be performed. The experiment was conducted on 20 texts formed using the language model GPT 3.5, where 10 texts have manifestations of depression and 10 without manifestations of

depression. The result of the classification and evaluations of the manifestation of the depressive state shows that the dual architecture did not make any mistakes during the classification, and its results, except for 3 texts out of 20, correlate with the GPT-2 and BERT transformer models. This is due to the fact that these models are powerful by themselves with a small margin of error, but when combined, their strengths are combined. BERT is better at parsing syntactic structures, while GPT-2 provides a deeper understanding of context.

Conclusions. The paper proposed the method of using neural network BERT-GPT2 dual transformer architecture for detecting persons depressive state designed to transform input data in the form of text and trained neural network BERT-GPT2 dual transformer architecture model into output data in the form of the numerical assessment of the presence of persons depressive state. The proposed method differs from analogues in that it combines a two-stream architecture, each of which specializes in the analysis of different aspects of the text, semantic and syntactic. Experiments were conducted with the use of the given developed software complex for detecting persons depressive state, which testify to the correctness of the proposed approach. From the performed performance study, the dual architecture did not make a single error during classification.

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