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Data-Driven Model for Emotion Detection in Russian Texts.

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Abstract

An important task in the field of automatic data analysis is detecting emotions in texts. The paper presents the approach of emotion recognition for text data in Russian. To conduct an emotion analysis, a method was created based on vector representations of words obtained by the ELMo language model, and subsequent processing by an ensemble classifier. To configure and test the created method, a specially prepared dataset of texts for five basic emotions -- joy, sadness, anger, fear, and surprise -- is used. The dataset was prepared using a crowdsourcing platform and a home-grown procedure for collecting and controlling annotators' markup. The overall accuracy is 0.78 (by the F1-macro score), which is currently the new state of the art for Russian. The results can be used for a wide range of tasks, for example: monitoring social moods, generating control signals for mobile robotic systems, etc.

Introduction

The problems of extracting automatically the emotions of the author manifested in their text are in high demand for a wide range of practical applications. The latter include, in particular, determining sources of threats of various types or the presence of illegal context, consulting and marketing systems, as well as a prospective application in the control interfaces of robotic devices as a means of determining the priority of a command. The problem under consideration has been extensively studied in the world; this is evidenced by the presence of labeled data samples, as well as a number of works on methods.

For the Russian language, however, the use of modern machine learning methods is inhibited due to the lack of a sufficient number of accessible labeled examples. Therefore, the task of creating and developing tools for recognizing the emotions of the author from texts written in Russian is relevant and is the goal of this work.

In this work, to implement the data-driven model for emotion detection, a special corpus of 9668 sentences was formed, labeled with five basic emotions: joy, sadness, anger, fear, and surprise.

The model for emotion detection in texts, is based on an ensemble of several classifiers which receive ELMo vector representation [1] of words as input features.

Sources of texts for a dataset

For the formation of the corpus, we collected sentences in Russian from several sources:

1. Posts of the LiveJournal social network;
2. Texts of the online news agency Lenta.ru;
3. Twitter microblog posts.

In total, 3107 sentences were selected from LiveJournal posts, 3131 sentences from Lenta.Ru, and 3430 sentences from Twitter.

After selection, sentences were offered to annotators for labeling.

Annotation procedure

Annotating sentences with labels of their emotions was performed with the help of a crowdsourcing platform Yandex.Toloka.

Only 30% of the best-performing active users (by the platform's internal rating) who spoke Russian and were over 18 years old were allowed into the annotation process.

Before a platform user could be employed as an annotator, they underwent a training task, after which they were to mark 25 trial samples with more than 80% agreement compared to the annotation that we had performed ourselves.

If the accuracy of an annotator on the control sentences (including the trial run) became less than 70%, or if the accuracy was less than 66% over the last six control samples, the annotator was dismissed.

Sentences were split into tasks and assigned to annotators so that each sentence was annotated at least three times.

Assigning emotion labels

The final label for the sentence was "No emotion" if less than 60% annotators put any emotion labels on it (regardless of their types).

A label of a specific emotion was assigned to a sentence if put by more than half of the annotators (except those who put "No emotion"). After such aggregation of annotators' labels, the corpus contains 9668 sentences, 5609 of which contain one or more emotions, and 4059 sentences contain none.

The number of labels by data source is presented in Table 1.

Table 1. The number of emotion labels in different subsets of our dataset

Data source	Joy	Sadness	Fear	Anger	Surprise	No emotions	Total sentences
Twitter	1233	1372	362	198	221	129	3430
Lenta.ru	190	92	126	121	195	2411	3131
LiveJournal	433	298	264	231	398	1519	3107
Total	1856	1762	752	550	814	4059	9668

Method

We propose a method based on an ensemble of binary classifiers, where each classifier, which predicts its own emotion separately, may be built on a different machine learning method.

For encoding a sentence we use vector representations of words obtained with the pretrained ELMo mode (see Figure 1).

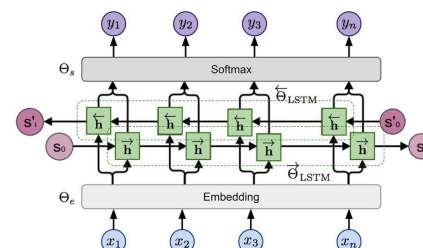


Figure 1. ELMo language model (the picture from [2])

The vector representation for the whole sentence is obtained by averaging the resulting word vectors.

The sentences thus encoded are processed with classifiers (see Figure 2), among which we test a set of supervised machine learning methods, including:

1. Support vector machine (SVM) with linear kernel;
2. Gradient boosting (XGB);
3. Stochastic gradient descent (SGD);
4. Logistic regression (LR).

Search for the hyperparameters of the models was performed with an AutoML method based on the TPOT library [3].

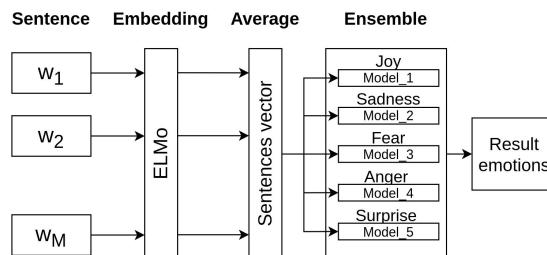


Figure 2. The scheme of the model for emotion recognition in a sentence

Results

While evaluating the proposed solution, we compare it against several basic estimates:

1. Random: The emotion label is chosen randomly for each sentence;
2. SVM (TF-IDF): The classifier based on SVM with linear kernel, where the input sentence is encoded with the TF-IDF frequency method using 4-to-8-long character n-grams;
3. Lexicon: The classifier based on dictionaries of emotive vocabulary [4].

The F1-scores of the selected classifiers in comparison with the results of the baseline methods are presented in Table 2.

Table 2. The results of detecting different emotions

Model	Joy		Sadness		Fear		Anger		Surprise		Mean	
	mic.	mac.	mic.	mac.	mic.	mac.	mic.	mac.	mic.	mac.	mic.	mac.
Random	0.5	0.45	0.52	0.45	0.51	0.39	0.5	0.38	0.5	0.4	0.51	0.41
SVM(TF-IDF)	0.87	0.71	0.88	0.72	0.94	0.68	0.95	0.53	0.93	0.69	0.91	0.66
Lexicon	0.76	0.65	0.7	0.59	0.79	0.65	0.76	0.62	0.79	0.64	0.76	0.63
Our approach	0.93	0.88	0.91	0.83	0.95	0.75	0.92	0.66	0.93	0.77	0.93	0.78

Conclusion

When training and testing on 80% and 20% of the dataset, the developed method demonstrates the F1-macro of 0.78, which exceeds random choice, the basic SVM classifier, and the dictionary method by 0.37, 0.12, and 0.15, respectively.

Based on the assembled corpus, the method for solving the emotion analysis problem has been proposed and validated. At its core are vector representations of sentences obtained by the ELMo deep learning language model and the ensemble of binary classifiers trained using an AutoML algorithm. The obtained accuracy is the new baseline for this type of task in Russian.

The dataset can be achieved by requesting through <https://sagteam.ru/en/> website.

Acknowledgments & References

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