CREATING EMOTION RECOGNITION ALGORITHMS BASED ON A CONVOLUTIONAL NEURAL NETWORK FOR SENTIMENT ANALYSIS

Vera Ivanyuk, Ekaterina Tsapina

ICPR 2020

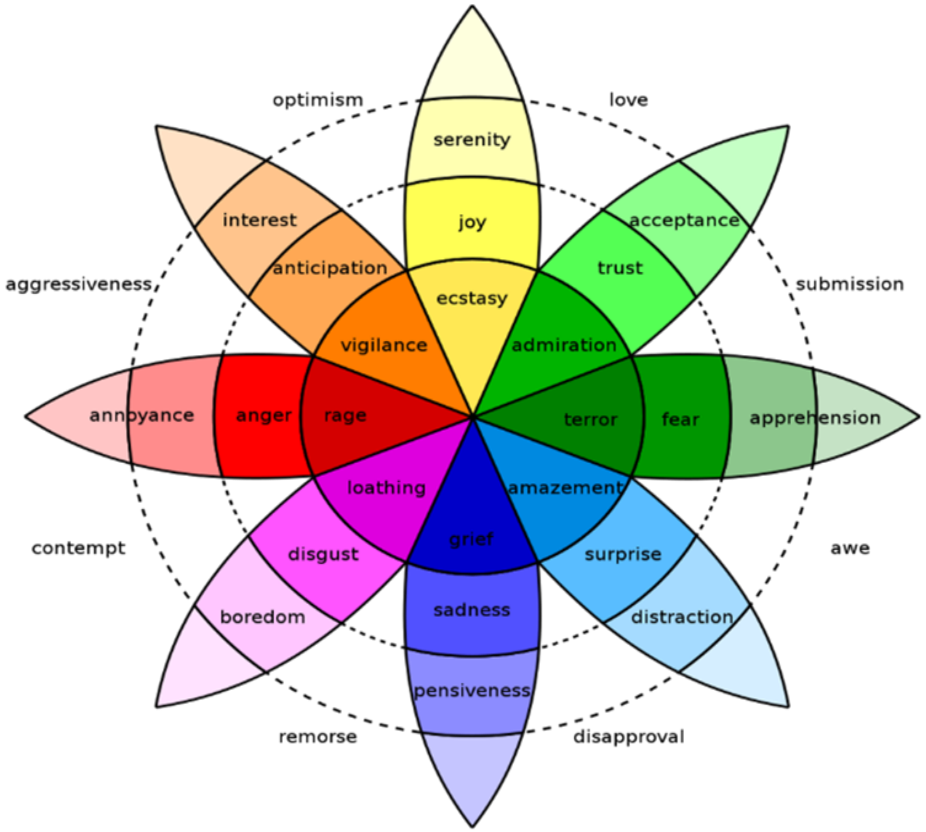
2021

FINANCIAL UNIVERSITY
UNDER THE GOVERNMENT OF THE RUSSIAN FEDERATION

Moscow, Russia

Emotion Recognition in Text

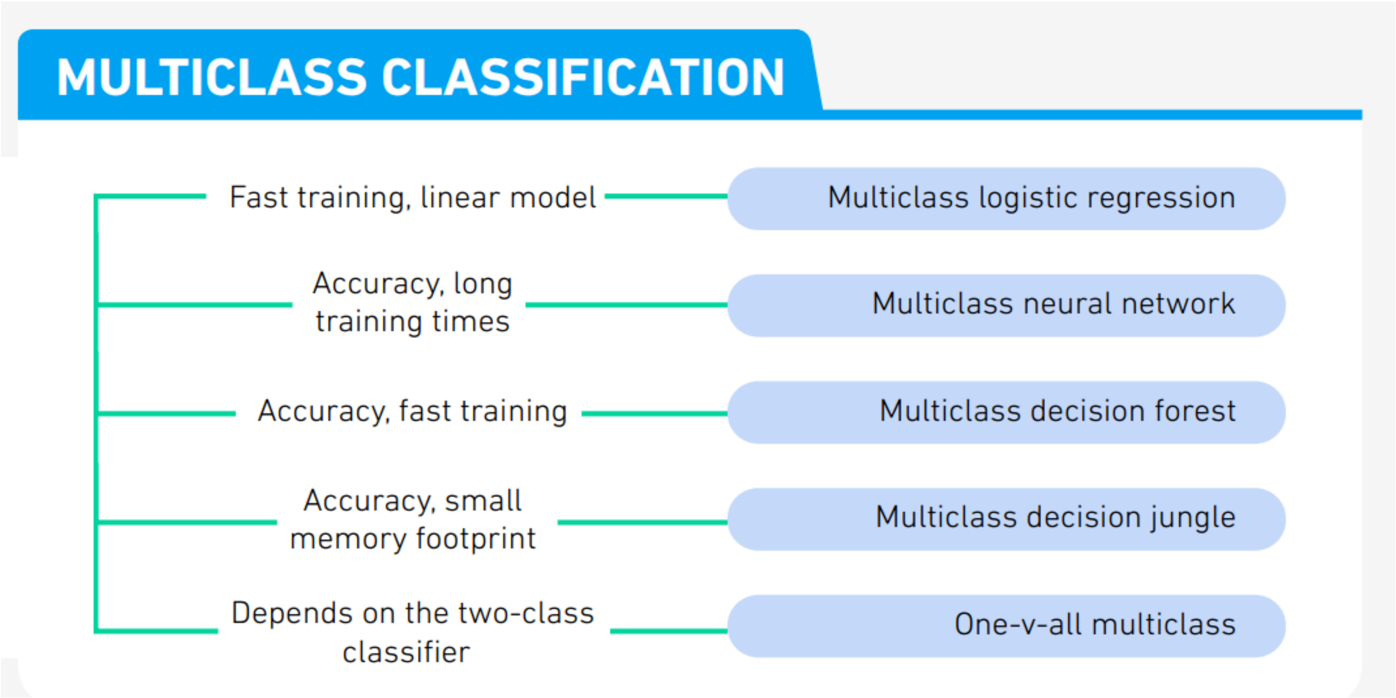
- One of the most urgent tasks in the development of the man-machine interface is the recognition of human emotions.
- Such Internet giants as Apple, Google, Amazon and Microsoft pay serious attention to the problem of emotion recognition, spending considerable scientific and financial resources to solve it.
- The complexity of the problem lies in the fact that human emotions are primarily a product of humoral regulation of the body having a wide range of values and combinations of values. For example, the concentration of stress hormones in the body can change more than 20 times in a few seconds. And the dopamine-serotonin complex can be characterized as a system that has a range of values that differ hundreds of times.
- Despite the existence of a clearly formalized emotion model used in psychology, today there are no automated systems for recognizing human emotions with an efficiency of more than 95%.



Recognition Automation

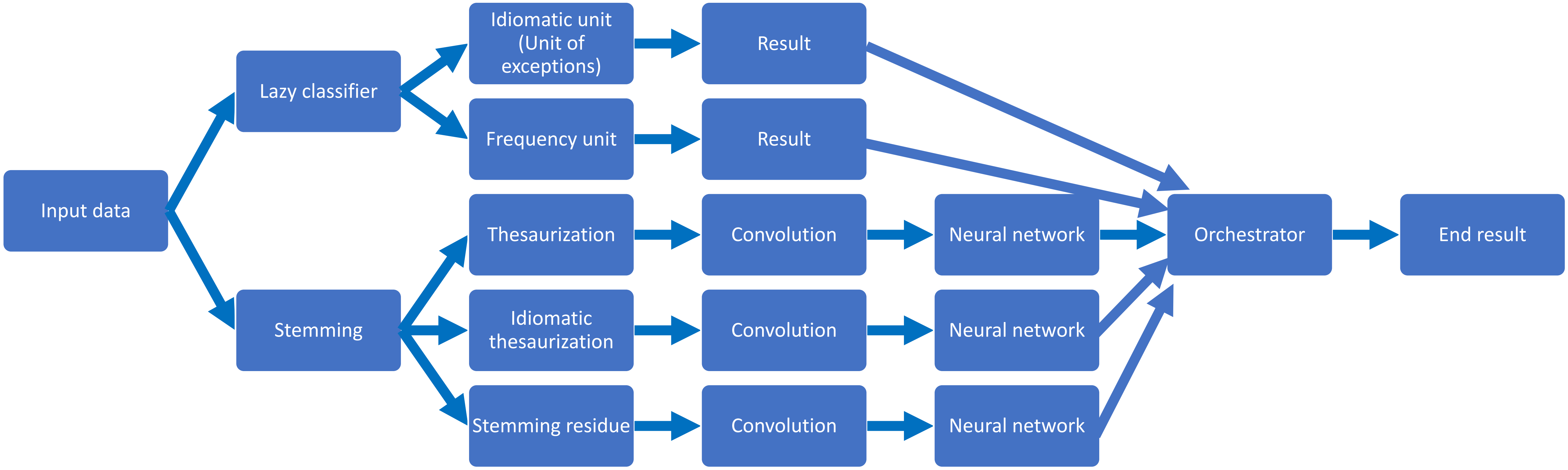
- The simplicity of emotion recognition indicates that this is the simplest classification task. However, despite all efforts, modern voice assistants or chat systems have only a rudimentary ability to perceive emotions and occasionally make gross – sometimes ridiculous – mistakes.
- The main difficulty here is the artificial coarsening of the classical psychological emotion recognition model which turns it into the simplest set of basic emotions, that excludes any intermediate or indefinite states.

Typical Classifiers of Sets



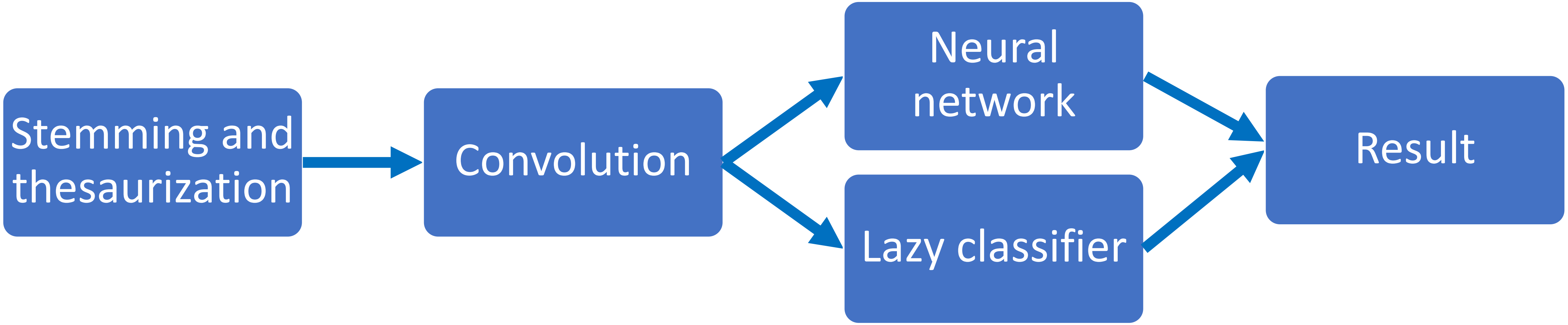
Mar 22, 2019, Stefan Kojouharov, Becoming Human: Artificial Intelligence Magazine

Preferable Architecture.



LAZY CLASSIFIER

A lazy classifier is, at its core, a database which is optimized for speed and contains ready-made answers for the most frequently repeated input combinations of the neural network. It allows not only to reduce the overall computational load of the system but also to significantly speed-up the classification process.



Stemming and Thesaurization

- Stemming is a method of identifying the semantic basis of a word by discarding suffixes and prefixes. It should be taken into consideration that in Russian, endings and prefixes form the sentiment of the word.

- Similar to stemming, thesaurization (replacing a word that the classifier did not learn with its synonym that was present in the training sample), seems very attractive in terms of optimizing the speed and memory size of the classifier.

- However, it should not be forgotten that not only homonyms but also many other words and phrases have a context-dependent sentiment, completely different from the substituted synonym.

Big Data – Big Mistakes

- An important factor in creating automatic classification systems is a deep analysis of the original data package used for training.

- It would seem that the larger the training and testing samples, the more accurately the network should perform. However, in practice, we see a completely opposite effect. The more data we use for training, the less efficient the network becomes. This is primarily due to the low quality of unprocessed training data.

- For example, the corpus of Russian texts RuTweetCorp contains 74% of emotionally ambiguous expressions, as well as phrases in Kazakh and Ukrainian, typed in Cyrillic.

Cultural and Linguistic Specifics

- Slavic languages have their own unique cultural and emotional context, which developed in the language paradigm of emotional socialism and accordingly distorted the sentiment of not only idiomatic and generic expressions but also individual words and phrases.

- Thus, many words, phrases, and synecdoches that traditionally carry a negative semantic charge gained a positive emotional connotation and vice versa.

- In the Russian language, there is a large number of fixed colloquialisms with meanings opposite to those of the words contained in them, as well as oxymorons and synecdoches. In sentiment analysis, these expressions must be treated as exceptions, either by separately considering them in lazy classifiers or by subjecting them to thesaurization.

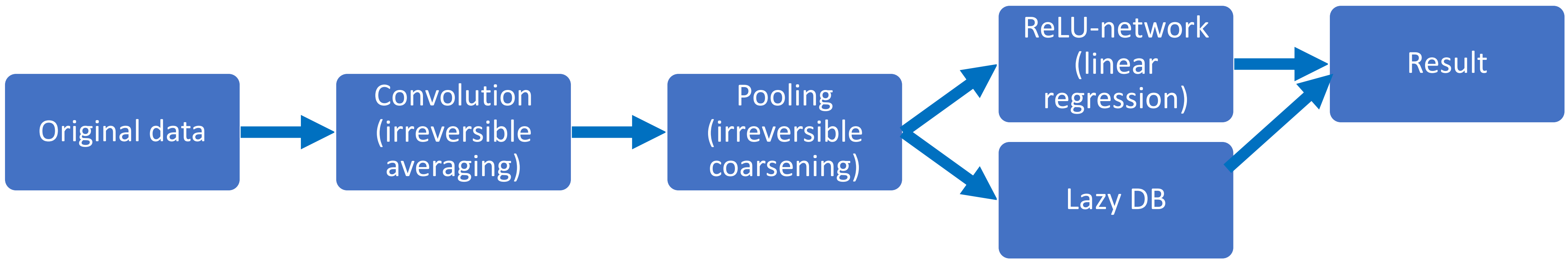
While presenting the research, we will focus on the following aspects:

1. **Dataset.**
2. **Solution Architecture.**
3. **SOTA-evaluation.**

Emotion Recognition Model

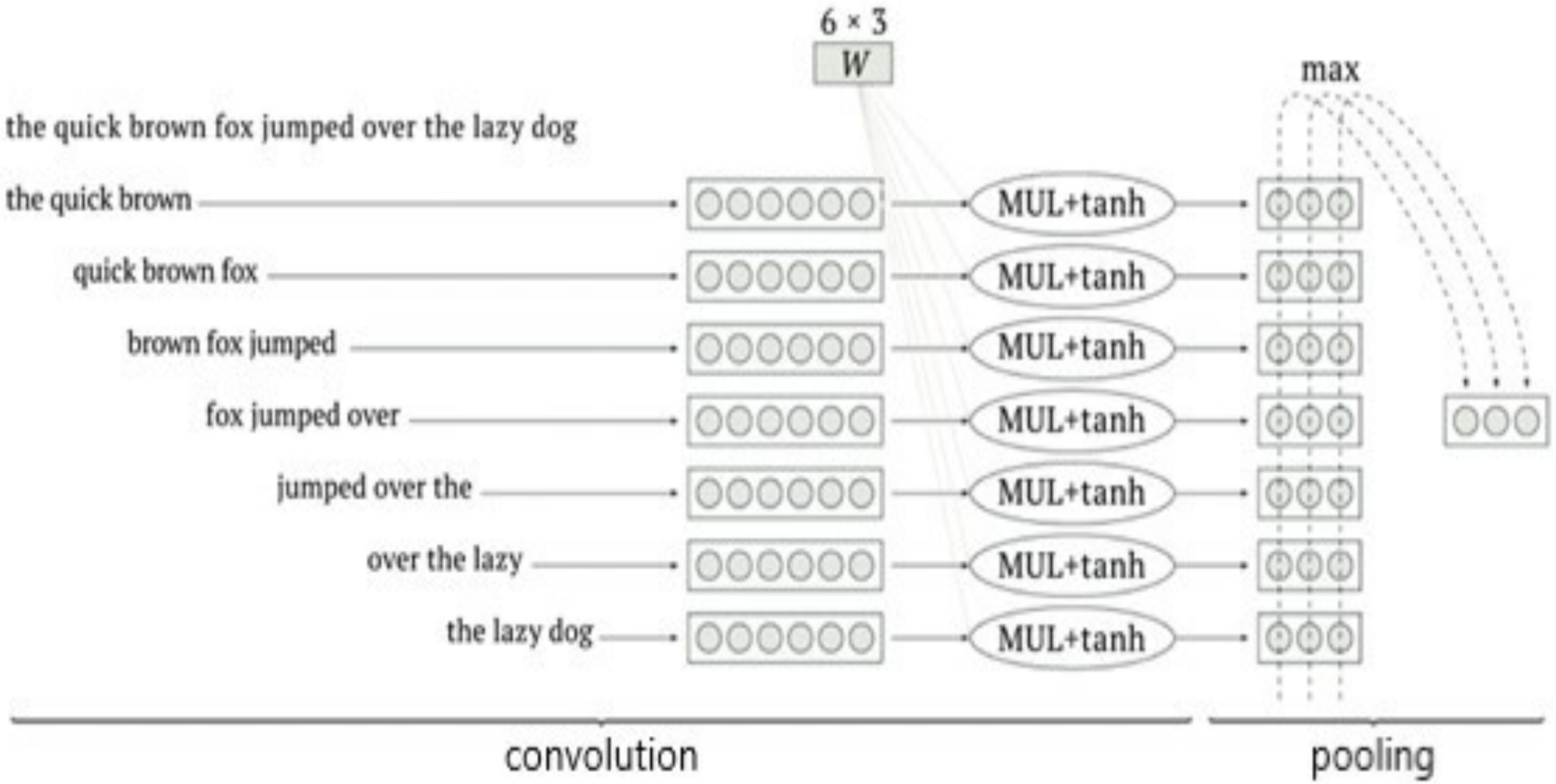
- **hate/disgust**
- **sad**
- **happy**
- **fear/surprise**

Network Architecture



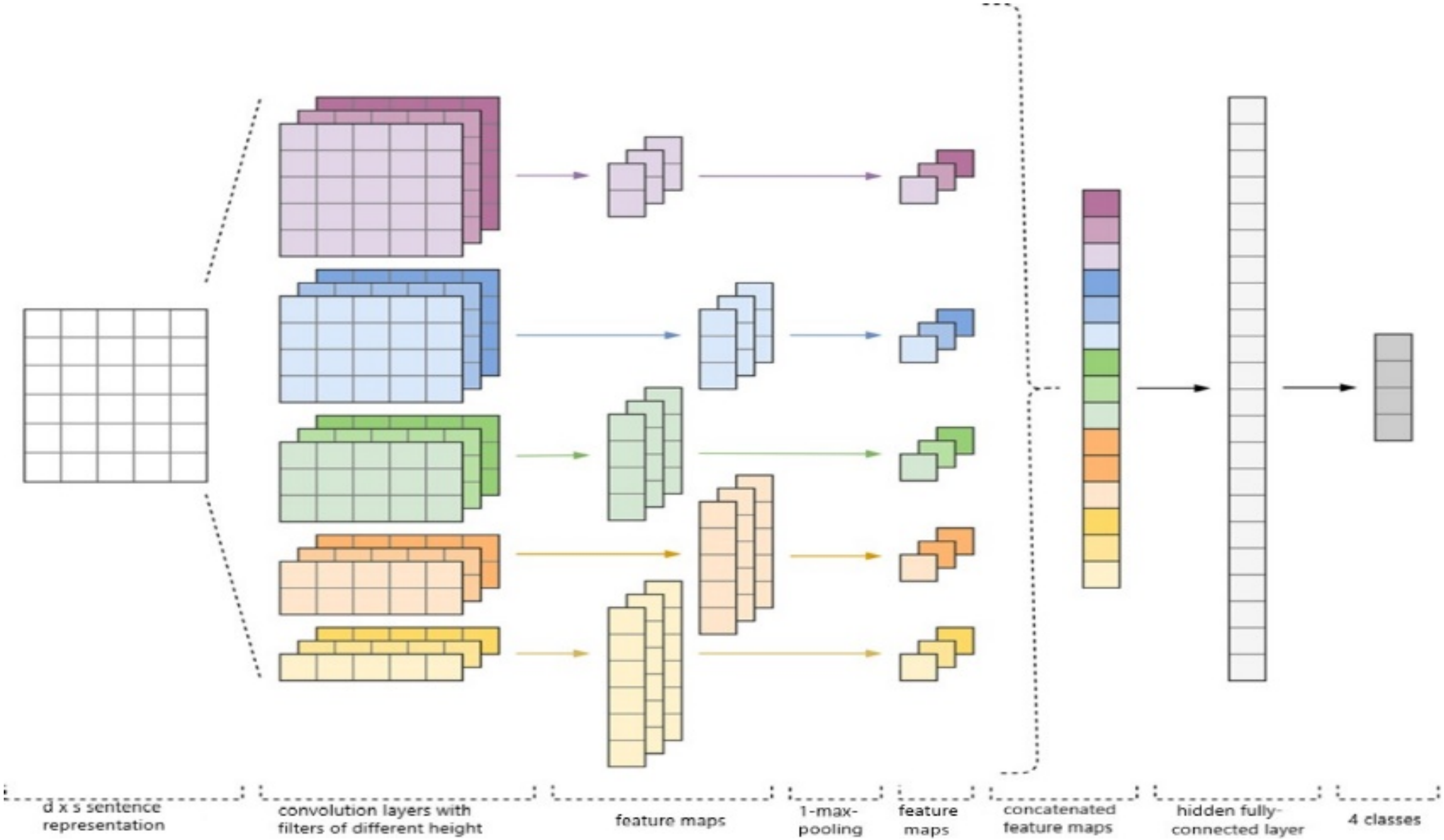
According to intuitive analysis, this type of classifier should have a very high learning rate and classification rate.

Convolution and Pooling

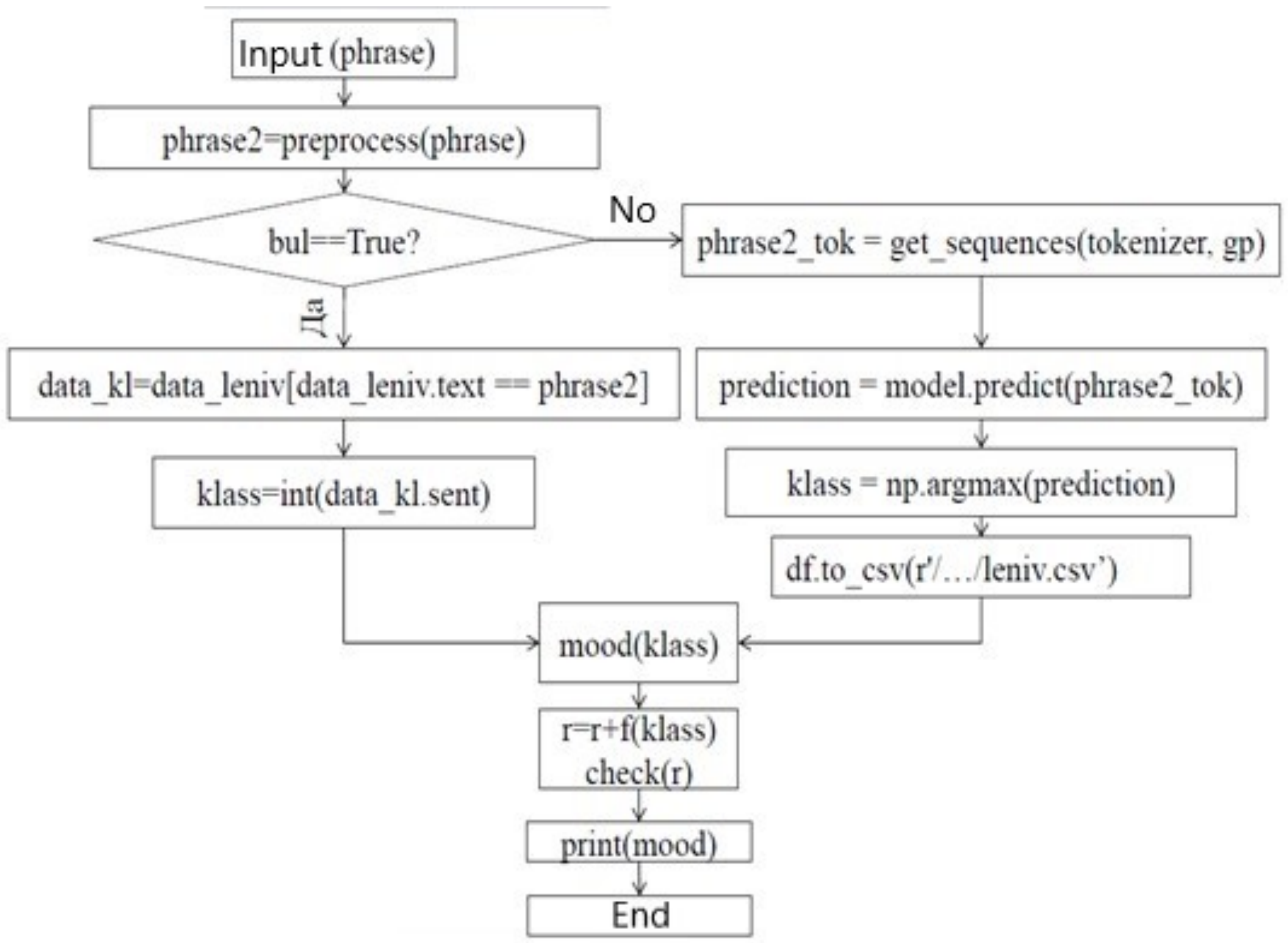


1D convolution + 1-max pooling over the sequence «the quick brown fox jumped over the lazy dog».
This is a convolution with a window of size 3.

Network topology



Software Algorithm



Analysis and Preprocessing

For training and testing of the classifier, the corpus of sentiment-marked short texts **RuTweetCorps** was used.

The analysis revealed phrases in the Kazakh and Ukrainian languages, as well as phrases with an implicit emotional connotation.

After removing implicit elements and foreign-language texts, the corpus was reduced to increase the quality of samples.

334 836 phrases → **18 484** phrases

Table of Emotion Classes

As a result, the below classes table was formed:

Class	Traning sample elements	Testing sample elements
0 - hate/disgust	2288	2288
1 - sad	2297	2297
2 - happy	2283	2283
3 - fear/surprise	2374	2374

Neural Network Training

- **15** epochs

with

- **17 610 000** error backpropagation cycles

and

- **712 844** unique words

in each epoch

Training Results

Class	Precision
0 - hate/disgust	0.9781
1 - sad	0.7682
2 - happy	0.7379
3 - fear/surprise	0.9647

Resulting average accuracy:

84.27%

SOTA – evaluation

Language specific algorithm	SOTA average accuracy	Dataset	Paper
M-BERT BaseFiT (Russian)	0.874	RuTweetCorp (full version)	https://github.com/sismetanin/sentiment-analysis-in-russian
Dual-trained Lazy CNN	0.843	RuTweetCorp (clean version)	present research
nb-blinov (Russian)	0.816	ROMIP-2012	https://arxiv.org/ftp/arxiv/papers/1808/1808.07851.pdf
Naive-Bayes + Thesaurus (Russian)	0.697	RuTweetCorp (full version)	https://www.fruct.org/publications/fruct23/files/Lag.pdf

Research Findings

- Contrary to intuitive assumptions and despite the simplicity of the architectural solution, the classifier based on linear regressors showed decent results outperforming both the naive Bayesian algorithm and the specialized neural network developed by Blinov.

- Hence, we can conclude that when designing systems for emotion recognition in written language, simplified and rather trivial solutions are not given enough attention, even though they perform quite efficiently, and, what is more important, are easily-reproducible on a non-dedicated architecture such as gate arrays and ASIC-processors.