

ABSTRACT

The theme: “Recognition of mathematical symbols using convolutional neural networks”.

Master thesis: 105 p., 36 fig., 1 appendix, 34 references.

Object of research is handwritten mathematical expressions.

Subject of research is methods used for recognition of handwritten mathematical expressions.

The goal of the work is development of effective offline algorithm for recognition of handwritten mathematical expressions, which based on convolutional neural networks, and analysis of its performance depending on usage of different underlying algorithms for image segmentation.

In this work analysis of existent approaches to recognition of handwritten text has been performed. New algorithm for recognition of handwritten mathematical expressions, which uses convolutional neural network as classifier, has been suggested. During image preprocessing Bradley’s binarization algorithm is being used, and after that binary image is being segmented. Segmented symbols of expression are being recognized by classifier, and after that, syntax tree of expression is being built using algorithm, which uses the set of grammatical rules and relative location of symbols. Based on experimentation results it was determined that the most effective is an algorithm, which based on modified algorithm for image segmentation and uses breadth-first search algorithm. It was also determined that the classification error rate for trained neural network is less than 1.1%. The advantages of suggested algorithm are ability to work offline, which means that a user do not need to input expressions in real time, and usage of highly effective classifier, which based on convolutional neural network.

Achieved results may be used for development of a system which would allow automatically recognize and digitalize existent and new mathematical manuscripts.

HANDWRITTEN EXPRESSION, BINARIZATION, SEGMENTATION, MATHEMATICAL EXPRESSION, RECOGNITION, CONVOLUTIONAL NEURAL NETWORK, FILTRATION.