Medical Image Classification Based on the Hybrid XGBoost Convolutional Neural Networks

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ABSTRACT

In recent years, Convolutional neural networks (CNNs) are the most effective models of artificial intelligence. They give good feature extraction, but they contain a large number of layers and parameters, which makes learning difficult. Therefore, their direct applicability to low-resource tasks is not easy. On the other hand, the eXtreme Gradient Boosting (XGBoost) model achieves higher global classification efficiency than other alternative models such as Bagging, Adaboost, SVM and Random Forest. Therefore, this paper first proposes the use of a trained convolutional neural network model for feature extraction from medical images, and then the use of these features by the eXtreme Gradient Boosting (XGBoost) algorithm to build softmax classifiers. This new CNN-XGBoost algorithm takes advantage of both CNN model and XGBoost classifier. The results demonstrate that the novel method used is more efficient than other methods, which confirms the relevance of the proposed approach for medical image classification problems.

Keywords: Image classification, Machine Learning, XGBoost

1 Introduction

The application of image mining on scanned exams is used for CAD (Computer-Aided Diagnosis) to help doctors identify and diagnose medical images. Convolutional neural networks (CNNs) [1] are the new revolutionary algorithm for feature extraction from images, which consists of multiple convoluted filters applied successively on the whole image. However, CNNs present a problem of low generalization capacity and overfitting because of the complexity of their operation. On the other hand, as an iterative integration method, The XGBoost [2] algorithm has proven its performance in many areas, including machine learning, as it has a flexible and portable library of gradient lifting with optimal distributed decision. It is based on second-order derivatives, regularization terms and on the tree structures, which enhances its performance. This paper uses the different CNNs models for feature extraction and the XGBoost algorithm for classification. This significantly reduces the redundancy of the parameters.

2 Methodology

Figure 1 shows the proposed CNN-XGBoost model. First, the input image data is standardized and is passed to the entry layer of CNN. Then, proposed CNN-XGBoost model is trained as a classical convolutional network to get the features and its output layer network is used to be the base learner of CNN-XGBoost model for the second learning. XGBoost model substitutes the output layer, a soft-max classifier, of CNN and utilizes the trainable features of CNN for learning. The CNN-XGBoost model can get features automatically and gives improved classification results by merging the two excellent classifiers.

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Figure 1: *Proposed CNN-XGBoost model*

The following section describes the two stages: the learning process of CNN model and XGBoost model.

2.1 Learning process of CNN

This step is performed with three architectures; ResNet-50 [3], VGG-19 [4] and DenseNet-169 [5] which they are adopted for gradient reduction learning.

2.2 Learning Process of XG-Boost classifier

In the XGBoost training step, the trained convolution network is used to get the features. The first trained Softmax classifier is utilized as the first base learner to regulate the data distribution probability of feature extraction. It takes the Softmax classifier trained from the convolution network output layer as the first basic learner of XGBoost; records the precision of training; sets the training weights of feature extraction data; and performs the multiple Softmax iterative training. Also fix all the Softmax classifiers and adopt their learning precisions as final voting weights; perform the embedded output of XGBoost.

3 Experimental Results

Figure 2 describes the experimental process. In fact, for the pre-trained CNN models including ResNet-50, VGG-19 and DenseNet169. This section measures their performance with a variety of classifiers, including SVM, XGBoost, RF, AdaBoost and KNN.

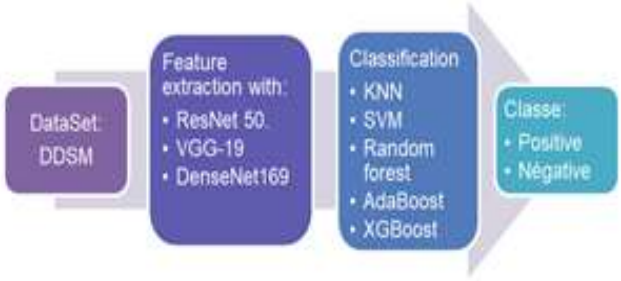

Figure 2: *Experimental process*

4 Conclusion

This paper uses CNNs with classification algorithms to improve the performance of learning algorithms in medical image identification. This study observes the effectiveness of different CNN models pre-trained with different classifiers. The best model discovered is the combination between the DenseNet-169 model for feature extraction and XgBoost for the classification phase.

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