Applied Mathematics and Computation 310 (2017) 1–14

Contents lists available at ScienceDirect

Applied Mathematics and Computation

journal homepage: www.elsevier.com/locate/amc

Enhanced ensemble-based classifier with boosting for pattern recognition

Eva Volna, Martin Kotyrba*

Department of Informatics and Computers, University of Ostrava, 30. dubna 22, 70103 Ostrava, Czech Republic

ARTICLE INFO

Keywords:
Neural networks
Classification
Boosting
Ensemble methods
Optimization

ABSTRACT

The aim of the article is a proposal of a classifier based on neural networks that will be applicable in machine digitization of incomplete and inaccurate data or data containing noise for the purpose of their classification (pattern recognition). The article is focused on the possibility of increasing the efficiency of the algorithms via their appropriate combination, and particularly increasing their reliability and reducing their time demands. Time demands do not mean runtime, nor its development, but time demands of applying the algorithm to a particular problem domain. In other words, the amount of professional labour that is needed for such an implementation. The article aims at methods from the field of pattern recognition, which primarily means various types of neural networks. The proposed approaches are verified experimentally.

1. Introduction

A classifier may be regarded as a computer based agent, which can perform a classification task. Classifiers can be divided into two categories [3]: rule-based classifiers and soft computing based classifiers.

Rule-based classifiers are generally constructed by the designer, where the designer defines rules for the interpretation of detected inputs.

This is in contrast to *soft-computing based classifiers*, where the designer only creates a basic framework for the interpretation of data. The training algorithms within such systems are responsible for the generation of rules for the correct interpretation of data.

In practice, there are often used soft-computing classifiers that use rule-based methods for preprocessing inputs before their own classification. Such classifiers are a combination of both approaches and their activities can be divided into two steps.

Selection of key features. Input data is preprocessed by algorithms, which extract the key features from the input objects. For feature extraction, there is no general rule. Their choice is related to a given application and it depends on the type of data.

Own classification. Features extracted from objects are presented to the classifier for classification.

A typical classification scheme is shown in Fig. 1, where two extreme situations may occur.

* Corresponding author.
E-mail addresses: eva.volna@osu.cz (E. Volna), martin.kotyrba@osu.cz (M. Kotyrba).

http://dx.doi.org/10.1016/j.amc.2017.04.019
0096-3003/

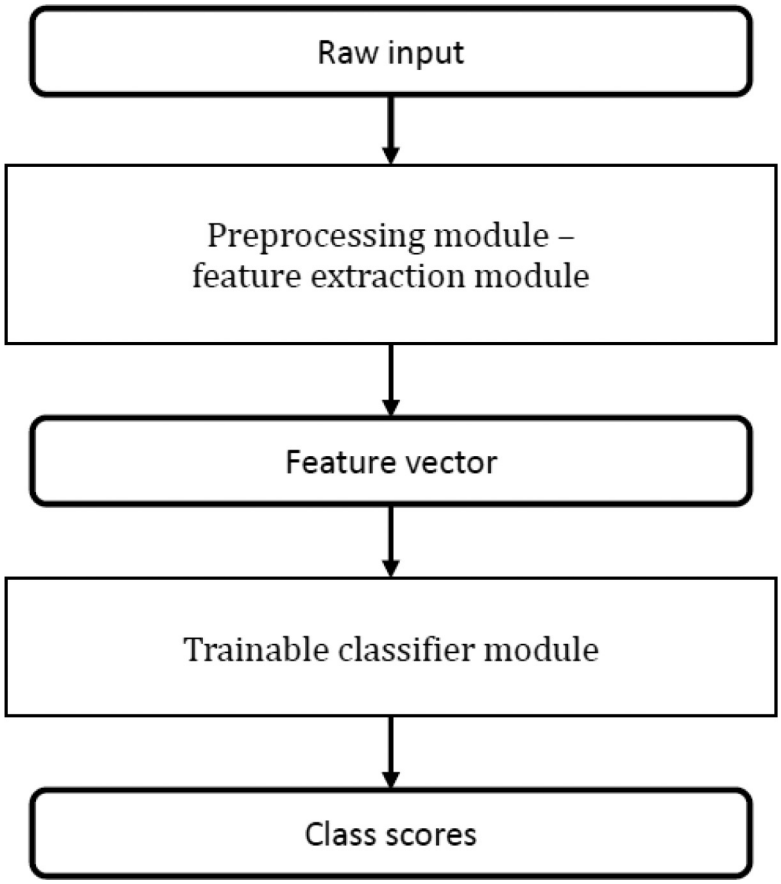

Fig. 1. General scheme of a classification task, adapted from [7].

Ideal preprocessing gives us absolute control over the classifier logic. The output of this preprocessing is the number of the class, which the input object belongs to. The task is thus solved during the first step and the use of a classifier is not necessary.

Ideal classifier gives us a better possibility of adaptation to a new problem area. In this case, a classifier, which is sufficiently "intelligent" is used in order that all input objects are correctly ranked without any preprocessing, i.e., it is able to independently deduce all key features of the input objects.

The article aims at proposing and developing such a classifier, which is able to suppress weak points of the selected algorithms.

- *Linear neural classifiers* provide poor diversity. The algorithm of the linear neural classifiers is almost deterministic. This property makes it virtually impossible to utilize the Hebbian network as a weak classifier in the AdaBoost. Therefore, the outcome of the article would be to develop some diversity-enhancing method, which would work with the linear classifiers.
- Adaptation process of the *backpropagation neural network* is very slow. As the AdaBoost is designed to utilize a high number of weak classifiers and profit from their diversity, therefore the outcome of the article would be to exploit the backpropagation's capabilities in some less time consuming way.

This paper contains a summary of adjustments for linear and multi-layer neural network that we have proposed. Our approach is based on the idea that it is more efficient to create a number of imperfectly adapted networks, which are smaller in their topology than one perfectly adapted sophisticated network. It also includes experimental studies that have verified impacts of these adjustments. The proposed optimization and adjustments concerned both the process of adaptation and preparation of patterns.

2. Proposal of enhanced classifier

Fig. 2 shows the proposed improvements, wherein each of them works with all neural network based classifiers.

- Optimization of training sets – irrelevant items elimination [5].