华南理工大学

South China University of Technology

The Experiment Report of Machine Learning

SCHOOL: SCHOOL OF SOFTWARE ENGINEERING

SUBJECT: SOFTWARE ENGINEERING

Author:
Jianing Ren, Ziqi Ruan and
Zhengying Xing

Supervisor:
Mingkui Tan

Student ID：
201530612651, 201530612668
And 201530613238

Grade:
Undergraduate

December 9, 2017

Face Classification Based on AdaBoost Algorithm

Abstract—
The AdaBoost algorithm is one of the most effective methods in regard to Face Detection.Although this algorithm has been proposed,many indepth research and analysis was provided by researchers.In this paper, we reviewed and resumed the process by ourselves. And we pay our attention to the performance using diverse kinds of weak learners to train Adaboost.

I. Introduction

ADABOOST (Adaptive Boosting), is a machine learning algorithm which was proposed by Yoav Freund and Robert Schapire. As a productive machine learning algorithm, AdaBoost has been widely used in many kinds of real application.

When used in Face Detection, AdaBoost algorithm creates a set of poor learners by maintaining a series of weights over training data and adjusts them after each weak learning cycle adaptively. The weights of the training samples which are misclassified by current weak learner will be increased while the weights of the samples which are correctly classified will be decreased. As the number of iterations increases, we can get a good strong learner.

In the next section, we will discuss the methods and theory of Adaboost in detail. After that, we conduct an experiment to verify the effectiveness of Adaboost for face recognition.In the last section, we summarizes our paper.

II. Methods and Theory

In this experiment, we are going to use the method Adaboost to do face detection. Adaboost is a classifier which combines weak learners to a strong learner. In this experiment, we choose decision tree as the weak learner. At the beginning, the weight of each sample is equal: all equal to 1/n. In each iteration, we train a new decision tree, and check if every samples are correctly classified. The samples which are not correctly classified are made to be more important, which means that we improve their weight. The weight of each sample is calculated according to this formula:

$$w_{m+1}(i) = \begin{cases} \frac{w_m(i)}{z_m} e^{-\alpha_m} & \text{for right predictive sample} \\ \frac{w_m(i)}{z_m} e^{\alpha_m} & \text{for wrong predictive sample} \end{cases}$$

where α is the importance of this base learner. For each base learner, we calculate its error rate:

$$\epsilon_m = p(h_m(\mathbf{x}_i) \neq y_i) = \sum_{i=1}^{n} w_m(i) \mathbb{I}(h_m(\mathbf{x}_i) \neq y_i)$$

we want the base learner with lower error rate more important, so the importance is:

$$\alpha_m = \frac{1}{2} \log \frac{1 - \epsilon_m}{\epsilon_m}$$

Then we give the final learner:

$$H(\mathbf{x}) = \text{sign}(\sum_{m=1}^{M} \alpha_m h_m(\mathbf{x}))$$

which is the sum of prediction of every base learn multiplied by its importance. If H(x) is positive, the sample is considered to be class 1, else it is considered to be class -1.

III. Experiment

A. Dataset

The dataset contains 1000 pictures(size:(250*250)), of which 500 are human face RGB images, the other 500 is a non-face RGB images. We divide 400 face images and 400 non-face images into training set, and the others into the validation set

B. Implementation

First, we converted 1000 pictures into a size of 24 * 24 grayscale. Give '1' labels to the positive samples and '-1' labels to the negative samples. Then extract NPD features and got a feature dimension of 165600 for each image.

Then, we use DecisionTreeClassifier as weak classifiers to set up an AdaBoost Classifier. The max_depth and amount of weak classifiers are three and twenty. We pass the weight ω as a parameter to the weak classifiers. After that, we use the AdaBoost model to fit the training data.

Finally, we predict and verify the accuracy on both training set and validation set using the AdaboostClassifier model. The result is showed in Table 1 and Table 2.

Table 1 Training result

	precision	recall	f1-score	support
non-face	1.00	1.00	1.00	400
face	1.00	1.00	1.00	400
avg / total	1.00	1.00	1.00	800

Table 2 Test result

	precision	recall	f1-score	support
non-face	0.97	0.98	0.98	100
face	0.98	0.97	0.97	100
avg / total	0.98	0.97	0.97	200

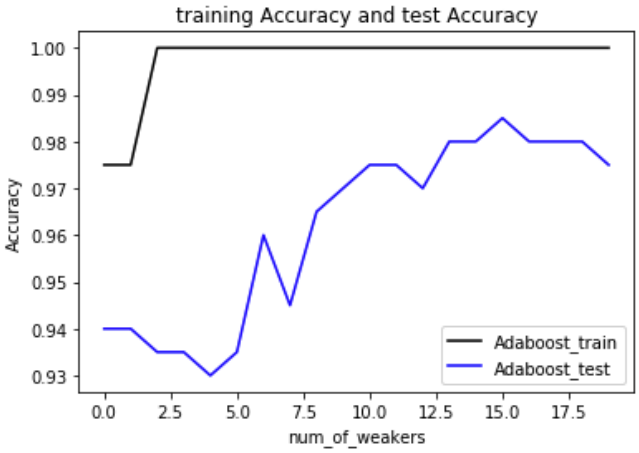

Figure 1 Prediction accuracy with increasing number of weak classifiers

IV. CONCLUSION

In this paper, we reviewed some fundamental knowledge about Adaboost used in Face Detection. And we verify the precision of this algorithm in our experiment. Through the process, we understand the theory of Adaboost better. In the same time, we enhance our coding ability.