Optical Character Recognition

Approach using k-nearest neighbors and Support vector machines

Alla Marchenko, Olav Markussen and Geir Kulia

April 23, 2017

1 Introduction

This report is presenting two approaches to Optical Character Recognition (OCR). The approaches applied are k-Nearest Neighbor Classifier and Support Vector Machines. A general overview of the implementation is shown in Figure 1. The data is loaded from the Char74k-Lite dataset and diveded, at random, into two databases. 80 % is selected as the training set, and 20 % is the test set. The data is then preprocessed, as described in section 2. A model is trained on the training set, before the model is passed to the classifier. The classifier is described in section 3. The system output is the classifier error, which is given by

$$E = \frac{N_{\text{fail}}}{N_{\text{test}}} \tag{1}$$

where N_{fail} is the number of wrong classifications in the test set and N_{test} is the total number of samples in the test set.

1.1 How to run the system

2 Feature Engineering

In this section, the preprocessing of the images are shown. The preprocessing is preformed to enable easier classification for the classifier. As two different

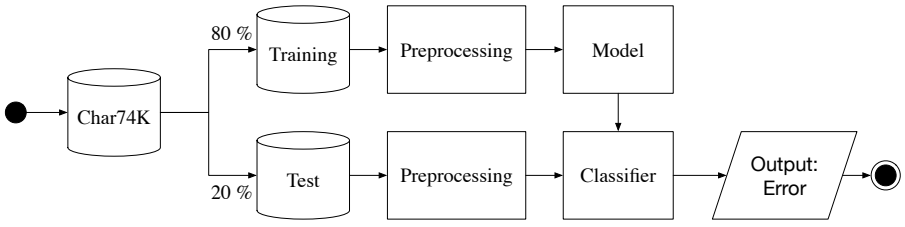
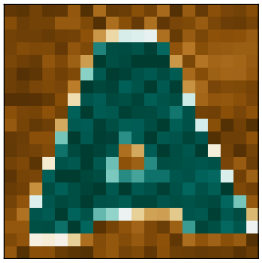
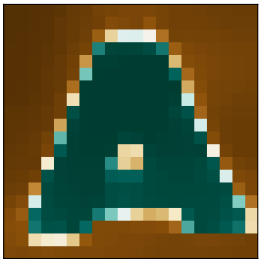


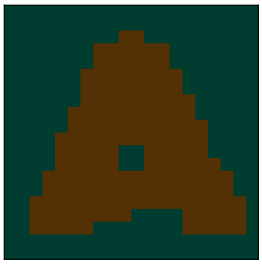
Figure 1: Model of OCR system.



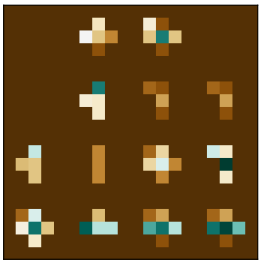
(a) Raw image.



(b) Denoised image.



(c) Binary image.



(d) Histogram of Oriented Gradients.

Figure 2: Example of random selected image before and after preprocessing. The colors has been altered using a color map to visually enhance variance.

classifier approaches are examined in this report, it will also explain two different setups with feature engineering.

2.1 Feature engineering for k-Nearest Neighbor Classifier

Several different preprocessing tools were explored to make the character easier to recognize for the classifier. The first preprocessing tool applied was total-variation denoising on n-dimensional images [1]. This technique reduces the total variation of an image. This is useful to avoid classifying noise, as the picture will now contain fewer components with high spacial frequency. An example of this denoising technique is shown in the image Figure 2b.

To increase contrast, we used Otsu's method, which is a way to perform image thresholding based on clustering [2] automatically. After thresholding, the image was morphologically closed. This is a standard technique in image processing to remove small wholes in binary images. The result is shown in Figure 2c. All though the result was visually pleasing; it did not decrease the error rate. Therefore, this method was discarded from further analysis.

The last preprocessing tool applied before dimention reduction was Histogram of Oriented Gradients. It is a feature descriptor uses local object appearences and shapes and describe them as a distribution of intensity gradients. It can be interpreted as the spacial derivative of the intencity of the image. The purpose of this step is to format the image for easier detection later as each element now carry more information than the pixels in the original.

2.1.1 Principal component analysis

It is a substaintian challange and computationally heavy to preform classification on high dimentional data. Therefore, a dimention reduction tool is preferable before performing a k-Nearest Neighbor Classifier. In this project, the Principal Component Analysis procedure was used for reducing the number of correlated dimentions down to a set of linearly uncorrelated principle component. The optimal condition for the k-Nearest Neighbor Classifier is when PCA is used to reduce the dimention down to

3 Classifier

References

[1] Antonin Chambolle. An algorithm for total variation minimization and applications. *Journal of Mathematical Imaging*, 2004.

[2] Nobuyuki Otsu. A threshold selection method from gray-level histograms. *IEEE Transactions on Systems, Man, and Cybernetics*, 1979.