

Interview Questions for Computational Imaging Group

August 26, 2019

Abstract

This assignment is designed to evaluate your skills on research, software development, and scientific analysis skills. You are allowed to use extra references, as long as you provided proper citation. You are expected submit (1) A report in pdf format, typeset with \LaTeX , (2) the Latex sources code, (3) corresponding source code (in Python) to reproduce the reported results.

1 Introduction

We have collected a large amount image hand-written digits data. However, during collection process a few of our system malfunctioned, and lead to some of the collected images being blurry; as shown in Fig. 1. Instead of manually separating all of the images manually, we have decided to use a machine learning approach! As provided, we have manually a limited number of samples provided in the **train.txt**, and a corresponding validation set in **val.txt**, and we want the labels for the examples in **test.txt**. We have provided some high-level ideas for you to work on. The data can be obtained at [\[Link\]](#).

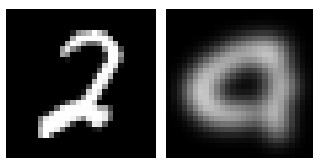


Figure 1: Image illustrations.

2 Linear Classifier

As can be seen, the aforementioned problem is a binary classification task, (*i.e.* Given an image x , find the corresponding label $y \in \{-1, +1\}$). One family of model for this task is linear model such as logistic regression or support vector machine. For this part of the assignment, we ask you to implement some feature extraction, Φ , on the image x follow

by a linear model. For this part of the implementation, **do not use predefined machine learning packages, such as libsvm, or scipy**. You are allowed to use Numpy and skimage for input output of the image.

In this section, we are evaluating your research implementation ability (*i.e.* code quality) and approach to a new research problem; (1) We look forward to a clean, readable and reproducible code. (2) We also look forward to interesting features that you would be able to come up with for this problem.

Report the final accuracy on the training and validation set, and the corresponding predictions for the test set (this should be the test.txt with labels filled in).

Hints for doing well: (1) Follow a python style guide, (2) modularize code, and (3) coherent description of the feature extraction process in the report.

3 Deep Neural Networks

Recently, deep neural networks have achieved state-of-the-art in many of the signal processing tasks. In this section, we ask you to use a deep neural network, with TensorFlow, for binary classification. Feel free to design/use any deep network you prefer. There are numerous online resources for binary classification with deep networks, be sure to provide proper citation if you use any of them. Lastly, report the final accuracy on the training and validation set, and submit the corresponding predictions for the test set (this should be the test.txt with labels filled in).

4 Report

The report should be in the format of a conference paper (4 pages + references). In particular, explain clearly what you did, and more importantly **why** you did it; Proper notation will be important. We also look forward to any analysis of the models. For example, you may want to visualize the learned parameters. As in a conference paper, try to convince us that the system you built is useful and practical.