Homework 1

ECE 285 Spring 2016

March 30, 2016

Instructions :

- Homework 1 is due by 11:59 PM, April 6, 2016.
- Submit your homework electronically by email to kcyuen+ece285@eng.ucsd.edu with the subject line *ECE 285: HW1*.
- The email should have one PDF file of your writeup attached. Make sure it includes your full name, PID, and email. This file must be named ECE_285_hw1_lastname_studentid.pdf.
- Append source code, floats, matrices, and image outputs, to your writeup where applicable. Simply pasting your code in the report should suffice, but make sure it is indented correctly.
- Carefully read and include the following sentences at the top of your report:

  Academic Integrity Policy: Integrity of scholarship is essential for an academic community. The University expects that both faculty and students will honor this principle and in so doing protect the validity of University intellectual work. For students, this means that all academic work will be done by the individual to whom it is assigned, without unauthorized aid of any kind. By including this in my report, I agree to abide by the Academic Integrity Policy mentioned above.

Assignment

This assignment is a basic introduction to go through the pipeline of basic classification. You will use two different datasets, extract features, train a classifier, and generate a confusion matrix and precision-recall curve to report your results.

(i) Download and describe (in detail) the following datasets:

- MNIST (`http://yann.lecun.com/exdb/mnist/`)
- CIFAR-10 (`https://www.cs.toronto.edu/~kriz/cifar.html`)

The datasets should have already been split into training and test sets. For training, you must further split the original training set into a smaller training set and a validation set. You may choose to do either a single split or cross-validation.

(ii) Select one feature from below:

- ACF (Aggregate Channel Features)
- HOG (Histogram of Oriented Gradients)

- SIFT (Scale-Invariant Feature Transform)

The feature extracted from your images will be used to train your classifier.

Some useful resources:
`http://vision.ucsd.edu/~pdollar/toolbox/doc/`
`http://www.vlfeat.org/overview/kdtree.html`

(iii) Select one classification algorithm from below:

- Artificial Neural Network (you may use raw pixel values as your "features" in this case)
- Random Forest
- SVM

Train two classifiers (one for MNIST and one for CIFAR-10) using the feature and classification algorithm you have selected. Fine-tune any parameters using your *validation test* (*not the test set*).

Some useful resources:
`http://caffe.berkeleyvision.org/`
`https://www.csie.ntu.edu.tw/~cjlin/libsvm/`

(iv) After finalizing your classifiers, present the following for your *validation set*:

- Overall classification accuracy (for each dataset)
- Confusion matrices (one for MNIST and one for CIFAR-10) to show classification performance
- Two precision-recall curves (one for MNIST and one for CIFAR-10). For the MNIST, treat the "0" class as the positive class and the rest as negative class. For CIFAR-10, treat "airplane" as the positive class and the rest as negative class.

(v) Repeat (iv) for the *test set*. For each dataset, explain in detail whether or not your classifiers generalize well or overfit?

Key things to include in your report:

- Academic integrity policy
- Description of dataset
- Selected feature and classification algorithm along with their parameters
- Details on training implementation (how was the validation set generated, how were the images and/or features preprocessed before training, etc...)
- Overall accuracy, confusion matrix, and precision-recall curves.
- Comments on results (including whether or not your classifiers generalized well or overfitted).