COMP 3314 / CSIS 0314 Machine Learning Assignment 4

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***Abstract*—A simple and fast model**

***Index Terms*—Semi-supervised, SVM, K-means, Bag of Visual Words**

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I. Introduction

At a high-level, what are the approaches you considered and why?
Provided 3000 labeled images, 31800 unlabeled images and 1200 test images, a "semi-supervised data set". We considered first supervised learning, with multiple choices of combination of,

- Pre-processing of Image Data
- Feature Extraction
- SVM Multiclass Classifier
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II. Method

1. Patches of size w*w are extracted randomly from the training images. 2. Each patch is normalized (zero mean, unit variance) and the whole set whitened. 3. The feature mapping is learned (in the case of k-means, the cluster centers are found). 4. In the classification phase, given an input image, patches covering the image are extracted (with shift s). 5. Each patch is normalized and the whole set whitened. 6. Features are extracted for each patch using the learned feature mapping. 7. To reduce the dimensionality of the resulting feature space, the input image is divided into four quadrants, and the learned values in each quadrant are summed up (pooled). 8. This new set of feature vectors is used when training the classifier.
In order to get a good network structure, we tuned parameters in above methods, such as

- receptive field size, w: the length of the side of each extracted patch
- stride size. The stride size s: the number of pixels the receptive field needs to shift to extract the next patch.
- number of features: i.e. the number of dimensions we want the input to be mapped to, or the number of visual words in the BOW model

A. Pre-processing of Image Data

We discovered the urgent need of pre-processing by playing a small trick on searching our sub-CIFAR10 data set among the original super CIFAR10 data set. Amazing result shows that not a single one data set is found in the original CIFAR10. Therefore it is valid to assume that conversion was made from original CIFAR10 set to get our sub-CIFAR10 set, e.g. adjusting the brightness, mirroring the image, etc.
1) utilize the unlabeled data: Intuition: unlabeled data is cheap; labeled data can be hard to get

- self-training
- Polynomial Kernel(LIBSVM)
- Gaussian Kernel(LIBSVM)
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2) Whitening: Subsubsection text here about Whitening
3) Normalization: Subsubsection text here about Normalization

B. Feature Extraction

Gist/Context(Background Scene) of a object or PCA

C. SVM Multiclass Classifier

If n is small and m is intermediate, then use SVM with a Gaussian Kernel.
SVM multiclass classifier with

- Linear Kernel(LIBLINEAR)
- Polynomial Kernel(LIBSVM)
- Gaussian Kernel(LIBSVM)
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How to choose and Tune different parameters, e.g. Gamma or C

D. K-Means Clustering

soft/hard k-means clustering to label the unlabeled image

III. Results

this part is about the results

Method	Training Accuracy	Test Accuracy (Public Score)
SVM	???	0.59333
K-means	1	0.68000
K-means	???	0.68667

IV. Conclusions

Summarize what youâĂŹve learned from the experiments and speculate on how you might improve the performance.
What makes your result good, and why? and/or, What makes your result unsatisfying, why, and how to improve?

V. Reference

Coates, A., Ng, A. Y., & Lee, H. (2011). An analysis of single-layer networks in unsupervised feature learning. In *International Conference on Artificial Intelligence and Statistics* (pp. 215-223).