Pattern Recognition –HW#4

About the Assignment

The main aim of the assignment is to learn SVM classification, feature extraction and feature selection. Contributions of this lab are;

- Ability to analyze the separable condition of features.
- Ability to analyze the non-separable condition of features.
- Understanding idea of feature extraction in machine learning.
- Understanding idea of feature selection in machine learning.

Step1:

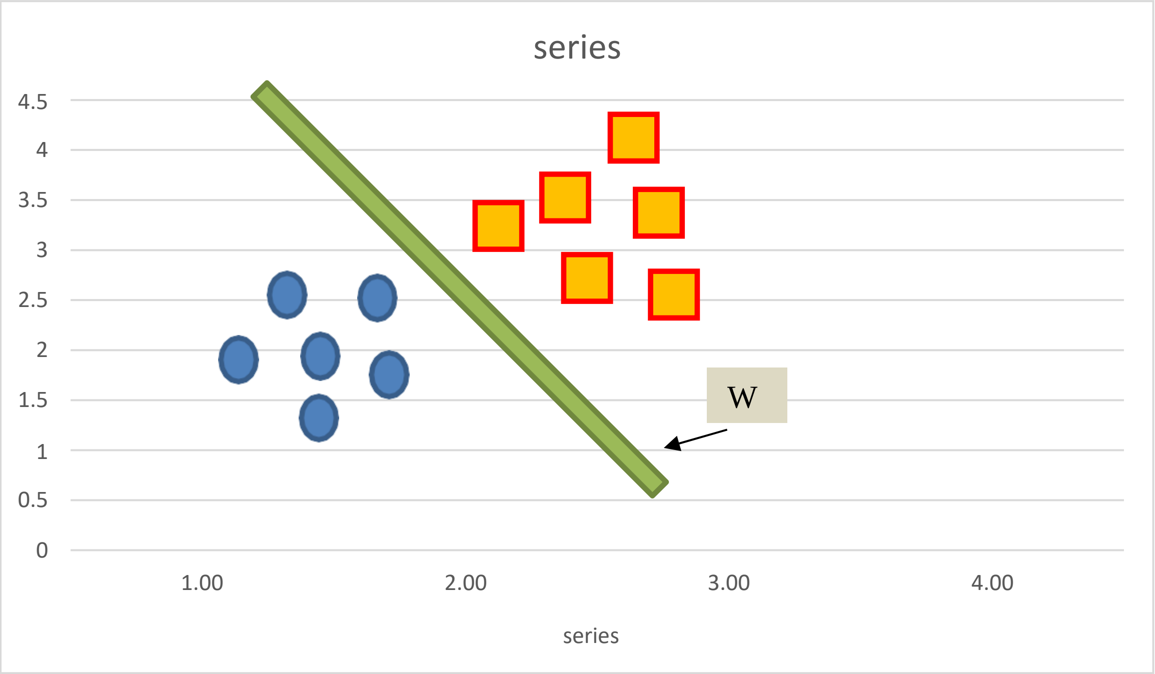


Fig. 1: A simple visualization of SVM.

In this HW, you are expected to make an experiment with SVM classifier, explained in class. Recall the previous homework, in like manner, the experiment will be conducted on the real life problem, called a classification problem among multi categories. The experiment is about Caltech-101 datasets, there are 15 classes, and each one contains different number of samples. The aim is to use SVM classifier, one-against-all methodology, in order to find different hyperplanes that is capable to separate classes.

According to one-against-all methodology, we have to find 15 hyperplanes in case of training stage, since there are 15 classes. In case of test case, the SVM will project a given test sample (test vector) onto each hyperplane, as represented with w in the Fig. 1. After observing the obtained scores, the SVM can make decision that the best-matched class is associated with best similarity score. It means that the higher similarity score refers to predicted target class of processed sample.

Step1: Feature Extraction

By running the given code, you can observe that an image is in the 128x128x3 format. Instead of using the whole image data (128x128x3 size), we have to extract some meaningful features in image. In this study, we will use following feature extraction method.

- In this study, we will extract ORB descriptors.
- https://scikit-image.org/docs/dev/api/skimage.feature.html#skimage.feature.ORB
- You can use any library to extract ORB descriptors.

You can see that an image will be represented only with ndarray features. We will extract ORB features from each image. For example, the dimension of feature vector per sample will be 1xn for an image. It means that training data (1457 samples) will be represented as (1457xn). Let's call the X matrix as training matrix and y is label vector, which keeps the class name of samples. The size of X matrix is (1457xn) and the size of y vector is (1457x1). You are expected to fill the X matrix with features and y vector with class label per each sample.

Step2: Feature Selection

The main motivation behind the feature selection is the dimension reduction. It means that we can reduce the feature size by eliminating the redundant ones. After feature selection, we will choose the more meaningful and rich features.

You can use any python library for feature selection process. Also, you can choose filter or wrapper approach. For feature selection, you can use two methods: Chi2 or mutual_info_classify.

https://stackoverflow.com/questions/51695769/sklearn-chi2-for-feature-selection

You are expected to reduce the size of feature vector from 1xM to 1xN format. In here N=M/2. Assume that the M=500 and N=250. The M refers to number of descriptors that are extracted from each image. N indicates the reduced dimension of descriptors after feature selection. It means that half of features will be removed after feature selection process is completed. The value of M and N depends on your selection. Show the overall accuracy.

Don’t use mlxtend library.

Step3:

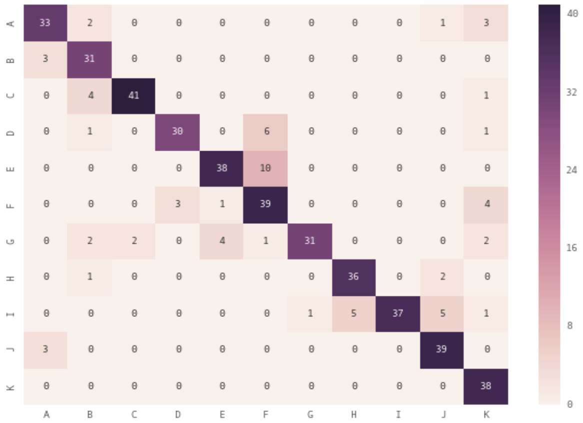
You are expected to train with SVM classifier. For this purpose, you can use the following SVM class.

- https://scikit-learn.org/stable/modules/generated/sklearn.svm.SVC.html

Step4:

You are expected to test with SVM classifier. Create confusion matrix and show the accuracy for test samples.

Use Seaborn to plot confusion matrix.



	A	B	C	D	E	F	G	H	I	J	K
A	33	2	0	0	0	0	0	0	0	1	3
B	3	31	0	0	0	0	0	0	0	0	0
C	0	4	41	0	0	0	0	0	0	0	1
D	0	1	0	30	0	6	0	0	0	0	1
E	0	0	0	0	38	10	0	0	0	0	0
F	0	0	0	3	1	39	0	0	0	0	4
G	0	2	2	0	4	1	31	0	0	0	2
H	0	1	0	0	0	0	0	36	0	2	0
I	0	0	0	0	0	0	1	5	37	5	1
J	3	0	0	0	0	0	0	0	0	39	0
K	0	0	0	0	0	0	0	0	0	0	38

https://stackoverflow.com/questions/35572000/how-can-i-plot-a-confusion-matrix

Submit the Assignment

Ex: No_Name_Surname_HW#.zip