**Final Project**

**Problem definition**

Given a set of raw labelled faces which has been detected and centered by the Viola Jones face detector and collected from the web.[1] The dataset contains insufficient and sufficient faces labelled with their names. Our job is to clean the data, feature the faces and learn from training data so that we can give a name with respect to the input face. In this problem, we treat each name as a class, so our goal is to classify the faces to the right classes.

For example:

Here we give a picture coming from the datasets.

***Input:***



Figure 1

***Output:***

Colin\_Powell

Actual class: Colin\_Powell

Answer: Right

**Data Dimension Reduction**

Images are often represented by high-dimensional pixel values, making them computationally expensive and challenging for machine learning models. PCA addresses this by extracting a set of principal components that capture the essential information in the images.

Aiming in filtering out noise present in images, PCA ensures that the transformed images retain the essential structures while minimizing the impact of irrelevant details. Here is the comparison of different number of PC.

|  |  |  |  |
| --- | --- | --- | --- |
| Number of Components | Accuracy | | |
| Eigenfaces | SVM | SAMME | RANDOM FOREST |
| 100 |  |  |  |
| 500 |  |  |  |
| 1000 |  |  |  |

**Muti-class SVM Using One Against All**

One-against-all SVM is based on binary SVM [2]. The concept is that, for each class, a binary SVM is constructed by treating it as the positive class and all samples of the remaining N-1 classes as the negative class.

The mathematical formulations for the SVM hinge loss function and parameter updates are as follows.

***Loss function:***

In this loss function, if a sample point is correctly classified, the loss is 0, otherwise the loss is

***Parameters update:***

The mathematical formula for parameter updating, using gradient descent, is an update of the gradient of the loss function with respect to weight and bias.

For weight :

For bias :

**Results:** The overall accuracy of our method is 92.28% while use SVM in sklearn the accuracy is 92.87%. We think we have achieved a good performance.

**References:**

1. <http://vis-www.cs.umass.edu/lfw/>
2. C. W. Hsu and C. J. Lin. 2002. A comparison of methods for multi-class support vector machines. IEEE Trans. Neural Networks. 13, 2, 415-425.