6.867 Project Proposal

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For our final project, we are interested in exploring classification techniques to classify facial emotions. Specifically, we would like to explore two methods that have been used in facial recognition. The first is to use principal component analysis to represent facial images in the basis of the first principal components and classify the resulting features with a multiclass classifier. In this part of the project, we want to understand and implement PCA and apply classification methods learned in class (neural networks, multiclass SVM).

The second method we want to explore is using convolutional neural networks on the raw images. In this part of the project, we want to understand and optimize the network structure of the CNN and compare its performance to the other methods along various performance metrics (correctness, training time, amount of training data required). We plan to use existing CNN libraries, and refer to the methods and results of Lawrence et. al. [1] and Matsugu et. al. [2].

This project can be clearly divided into using PCA for feature extraction from images for classification and using convolutional neural networks for classification with little image preprocessing. The project could then follow the rough timeline:

1. We first implement a baseline classifier using PCA and a neural network classifier. We will evaluate the performance in terms of correctness, training time, and amount of training data required.

2. We will then implement a multiclass SVM classifier with PCA features. We will evaluate this method and compare it to the first method.

3. Finally, we will implement a convolutional neural network classifier (using existing libraries). We expect this to be the most conceptually difficult, because we will need to optimize the network structure to prevent overfitting and have reasonable training times, among other concerns.

4. We will finally evaluate the performance of the CNN along the aforementioned metrics and compare to the other methods explored.

Our goals in this project are to learn more about PCA and CNNs and their application to image processing and classification. However we recognize that there are some risks associated with this proposal, because we do not have background in either. Our concerns with CNNs especially is the amount of training data and training time they require for high performance. Although we do not think it will be likely, in the event that training the CNN to high performance becomes intractable, we can perform partial analysis and comparison to the other listed methods. Because this project is a comparison study of several approaches, we can be slightly more flexible in the case of insurmountable difficulties in any one method.

References

[1] Lawrence, S.; Giles, L.; Tsoi, A. C.; Back, A. D. (1997) "Face Recognition: A Convolutional Neural-Network Approach" *Neural Networks, IEEE transactions on* 8 (1):98-113

[2] Matsugu, M.; Mori, K.; Mitari Y.; Kaneda Y. (2003) "Subject independent facial expression recognition with robust face detection using a convolutional neural network" *Neural Networks* 16 (5):555-559