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. Implement a baseline classifier using PCA and a neural network classifier. Evaluate the performance in terms of correctness, training time, and amount of training data required.
2. Refine and add features to the baseline classifier. Implement a multiclass SVM classifier with PCA features and evaluate.
3. Implement a convolutional neural network classifier using existing libraries.
4. Refine and compare the CNN 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. However, because this project is a comparison study of several approaches, we hope to have sufficient analysis on this relatively standard classification problem.

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