CSE 475: Statistical Methods in AI **Monsoon 2019**

Assignment 2: Face Classification/Verification

Lecturer: C. V. Jawahar *Date: 8/10/19*

1 Setting

1.1 Objectives

The objective of this assignment is to get you familiarize with the problems of "classification" and "verification" with a popular problem space of "face". You are provided with

- Datasets (in some standard form)
- Code for feature extraction/classification. (some from course other from popular library).

What is expected at the end (i) Familiarity with this (a specific) problem space and the associated nuances. (ii) some exposure to the visualization of data (iii) conduct experiments and report results (iv) use of graphs/tables to present results (v) decide parameters yourself ("best" according to you) and defend your choices. (vi) creating a brief report, with examples/arguments.

- **Out:** Oct 20
- **In:** Oct 31 11:55pm

1.2 Dataset

You are given 3 different datasets. Each dataset has faces images of humans. You need to perform experiments on these images.

Yale Face Database This is a classical data set. See original data and description at [1]. Worth reading. We have subsampled the following data for this experiment.

- You are given faces images of 15 subjects.
- Each subject has 11 images with different emotions.
- An *emotion.txt* is also given which contains mapping the emotion of each image.

Indian Movie Face Database This is an Indian data set. See original data and description at [2]. Worth reading. We have subsampled the following data for this experiment.

- You are given face images of 8 Indian movie actors.
- 50 images are provided for each actor.

IIIT Cartoon Face Dataset This is not natural face. But you still recognize. See original data and description at [3]. Worth reading. We have sub-sampled the following data

- Cartoon faces of 8 subjects.
- 100 images are provided for each subject.

You can download and use data from original sources. However, to make life simple, a version is downloaded and shared with you. For each dataset you are given files $< a >\_< b >$ *.png which is the bth face image of ath actor.*

1.3 Image Features

You are expected to use 6 different features/representations. These features are: (a) PCA/Eigen face (b) KernelPCA (c) LDA/Fisher face (d) Kernel Fisher Face (e) VGGFace (f) ResNet features

You are given a sample code for all the above six representations/features. You can modify or find a better implementation, if you prefer. If there are computational issues, we will consider giving you the features itself directly.

You are free to improve the basic implementations/links provided by us.

2 Questions

2.1 Basic Questions

1. Understand the "Eigen Faces". How many eigen vectors/faces are required to "satisfactorily" reconstruct a person in these three datasets? (Don't forget to

make your argument based on eigen value spectrum. Show appropriate graphs, qualitative examples and make a convincing argument.)

Which person/identity is difficult to represent compactly with fewer eigen vectors? Why is that? Explain with your empirical observations and intuitive answers.

Which dataset is difficult to represent compactly with fewer eigen vectors? Why is it so? Explain with your empirical observations and intuitive answers.

2. Use an MLP classifier and find the classification accuracy. Which method works well? Do a comparitive study.

   You already know the paper "Face Recognition Using Kernel Methods ". See this as an example for empirical analysis of different features/classification.

3. Use t-SNE based visilization of faces? Does it make sense? Do you see similar people coming together? or something else? Can you do visualization dataset wise and combined?

   You might have seen such data visualization plots in the past at different places. Here you will use a popular implementation.

   (Worth reading and understanding t-SNE. We will not discuss it in the class and out of scope for this course/exams.)

4. In practice "face" is used for verification. i.e., input is "identity/classID) and the face image" and response is "Yes" or "No". (i) How do we formulate the problem using KNN (ii) How do we analyze the performance ? suggest the metrics (like accuracy) that is appropriate for this task. Show empirical results with all the representations and variations in K.

2.2 Extension/Application

You know the basic pipeline for recognizing face now. Extend this to "one" of the following or similar problems.

You are free to use a new dataset that is publicly available or even create one by crawling from internet.

1. Politicians vs Filmstars in a public data set. (eg. LFW)
2. Age prediction
3. Gender prediction
4. Emotion classification
5. cartoon vs Real
6. your-own-problem

- Briefly explain the problem. Why the problem is not trivial.
- Why a solution to this may be of some use. Suggest good applications. Suggest good reasons why solving your problem is
- Explain your experimental pipeline, splits, evaluation metrics, quantitative results, qualitative results.

2.3 Technical Report

Submit a technical report (Not more than two page text in the same/similar template of this question sheet or lecture notes) with additional two pages of figures/plots/graphs.

- You should learn/attempt how to create "nice" and "impressive" figures, plots, visualizations, insighful graphics to explain the methods etc.
- You should learn/attempt to write technical content. Preferably use latex. (learn that too.).

3 Submission and Instructions

Jupyter notebooks will be used for this assignment.

1. A Jupyter notebook with detailed instructions and function stubs will be shared.
2. You must write your code in the indicated code cells and analysis in the indicated text cells.
3. Do NOT attempt to modify any other cells.
4. Ensure that the notebook runs without errors if the code cells are run in sequence.
5. Rename the completed notebook to

   `<rollnumber>.ipynb`

6. Upload the notebook, report and classification results as a zip file to moodle. Name the zip file as

   `<rollnumber>_assignment2.zip`

   .

7. **We'll check for plagiarism. So don't copy from someone else or online. Any malpractice will lead to zero in all assignments/projects or F grade in course.**

References

[1] Yale Face Database,Url:https://vismod.media.mit.edu /vismod/classes/mas622-00/dataset

[2] Shankar Setty, Moula Husain, Parisa Beham, Jyothi Gudavalli, Menaka Kandasamy, Radhesyam Vaddi, Vidyagouri Hemadri, J C Karure, Raja Raju, Rajan, Vijay Kumar and C V Jawahar. "Indian Movie Face Database: A Benchmark for Face Recognition Under Wide Variations", NCVPRIPG-2013

[3] Mishra, A., Nandan Rai, S., Mishra, A. and Jawahar, C. V., "IIIT-CFW: A Benchmark Database of Cartoon Faces in the Wild", VASE ECCVW-2016