Fall 2019: CSI5139F
Assignment 2

Due: Wednesday, October 23rd, 2019, 11:00pm in Virtual Campus
University of Ottawa - Université d'Ottawa

Jochen Lang

1 Normalized Face Image Comparison

This assignment will explores template matching and the multilayer perceptron with face sample data. We will be using the face database by Dr. Mian at the University of Western Australia [1, 2]. The database is recorded with 3D scanning in mind but we will be using only the face images recorded and ignore the VRML 3D models. The database is large and you are asked to *not* submit the images to *Virtual Campus*. We will be using two subsets of images: The subset for Subjects 1-10 will be your training and validation dataset. The subset for Subjects 31-40 will be your test set. You are not allowed to use the testset for anything else than for your final assessment of the approaches in Section 1.4.

1.1 Getting Started [1]

You will need to download the two subsets for participants 1-10 and 31-40 from
`http://staffhome.ecm.uwa.edu.au/ 00053650/databases.html`.
Unpack the images in a directory relative to your jupyter notebook. We will be marking your notebook with the data installed in sub1to10 and sub31to40 and your notebook will have to work with the images at these locations. Do not rename images, directories or reorganize the data. You will loose marks if your notebook does not work with images at the expected locations. Write a python function to read the images into your notebook and rescale the images to 64×64.

1.2 Template Matching [2.5]

Write a function that accepts two of the images and calculates a score based on the similarity of the two images using either cross-correlation, convolution or sum of squared differences. Choose your method carefully and perform any processing step necessary. Given the similarity score, perform a simple classification using a threshold to decide if two images show the same face. Evaluate your classifier with pairs chosen from the 460 images in the training data set. There are a total of $\sum_{i=1}^{N-1} i = \frac{(N-1)(N-2)}{2} = 105,111$ pairs but most of the pairs will show different faces. A small validation set of $1,000$ pairs of images seems therefore reasonable.

1.3 Perceptron [3]

Build a multilayer perceptron model (similar to the MNIST example shown in class) to classify an image pair as shwowing the same face or different faces. You will need to feed in pairs of images by concatenating them into your network. The simplest approach is to concatenate the pair of

image, i.e., you will end up with an input of 128×64. For this part of the assignment, you must build and train the Multi-layer perceptron model with scikit-learn, or alternatively with the Keras API of tensorflow. Use the same validation set as in Section 1.2 to evaluate your classifier.

1.4 Classification Comparison [1.5]

Compare the classifier of Sections 1.2 and 1.3 on the data subset for Subjects 31-40. Consider classifier performance but also other criterias, e.g., training effort, prediction speed, generalization and robustness. Your brief discussion based on quantifiable criteria need to be contained in your Jupyter notebook.

1.5 Feature Engineering [Bonus]

Considering the results for Sections 1.2 and 1.3 design an improved classifier that uses a multilayer perceptron for classification but uses some form of correlation to derive features. Discuss when and why your approach improves the classification results.

2 Submission

You will need to submit your solution in a Jupyter file, do *not* submit the image data. Make sure you have run all the cells. All text must be embedded in the Jupyter file, I will not look at separately submitted text files. If your Jupyter file needs a local python file to run, please submit it as well. Assignment submission is only though Virtual Campus by the deadline. No late submissions are allowed, you can submit multiple times but only your last submission is kept and marked.

References

[1] A. S. Mian, "Illumination invariant recognition and 3d reconstruction of faces using desktop optics," *Optics express*, vol. 19, no. 8, pp. 7491–7506, 2011.

[2] A. S. Mian, "Shade face: multiple image-based 3d face recognition," in *12th International Conference on Computer Vision Workshops (3D Digital Imaging and Modeling)*, pp. 1833–1839, IEEE, 2009.