Assignment #1: Fingerprint Recognition

Luka Bajić
IBB 2024/25 , FRI, UL
lb4129@student.uni-lj.si

I. Introduction

This paper presents an implementation of a simple fingerprint classification algorithm using a small dataset and already existing libraries for calculating similarity scores.

II. Methodology

For the purpose of comparing fingerprints, we first have to extract minutiae points from each sample and then calculate the distance between the two that we wish to compare. The classification is implemented with a simple threshold, which can be obtained from a graph of genuine/impostor sample distributions and then slightly adjusted empirically based on the classification accuracy on a particular training set.

III. Experiments

The dataset used for the experiments was FVC2004 DB1 B [1]. Due to its relatively small size, the whole dataset was treated as the learning data for classification. The code was implemented in Python with NBIS libraries.

IV. Results and Discussion

First subsection shows some key visualisations of the data, second subsection discusses the classification accuracy.

A. Results

Fig. 1 shows quality classes for every image (1 being the highest quality according to the nfiq estimator). Fig. 2 shows a visualisation of similarity scores for each pair of subjects (comparison of a subject with itself is included to showcase the total amount of minutiae point in an image). Fig. 3 shows two curves for distributions of genuine and impostor samples. Due to a small dataset, the curve for genuine samples doesn't resemble a Gaussian distribution.

B. Discussion

For a classifier with threshold value 19, the classification accuracy is 0.973. If we add an additional grouping by *psasys* classes, the classification accuracy is 0.932 (the accuracy drops due to small sample size: the number of mismatches drops slightly, but the number of total comparisons drops considerably).

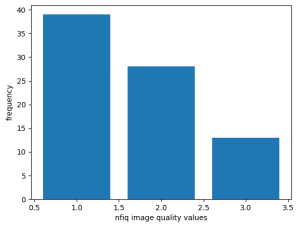

Fig. 1. Frequencies of images in the entire dataset, grouped by nfiq image quality values 1, 2, and 3

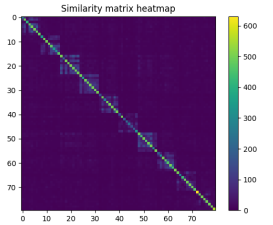

Fig. 2. Heatmap of a similarity matrix for all fingerprints in the database, based on bozorth3 values

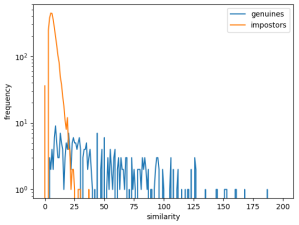

Fig. 3. Distributions of genuine and impostor samples respectively (the scale is logarithmic on account of the number of impostors being a degree of magnitude higher)

V. Conclusion

The classifier yields satisfactory results on the test dataset and should be suitable for usage in larger applications, presumably with minor parameter adjustments.

References

[1] R. Važan. Fingerprint dataset collection. [Online]. Available: https://github.com/robertvazan/fingerprint-datasets