

Homework 1

CSE 402 - Biometrics and Pattern Recognition

Instructor: Dr. Arun Ross

Due Date: September 21, 2022 (11:00 pm)

Total Points: 60

Note:

- ☐ You are permitted to discuss the following questions with others in the class.
 - ☐ **However, you *must* write up your own answers to these questions. Any indication to the contrary will be considered an act of academic dishonesty.**
 - ☐ A neatly typed report with detailed answers is expected. The report must be uploaded in D2L in PDF format.
 - ☐ All outputs, such as graphs and images, must be included in the report.
 - ☐ Any code developed as part of the assignment must be (a) included as an appendix in the report, as well as (b) archived in a single zip file and uploaded in D2L.
 - ☐ Include a bibliography at the end of the report indicating the resources that you used (e.g., URL, scientific articles, books, etc.) to complete this homework.
 - ☐ Please submit the report (PDF) and the code (Zip file) as two separate files in D2L.
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1. [15 points] Read the following paper by Patel et al. and answer the questions below. Your answer must be written clearly and in complete sentences.

Patel et al., "Continuous User Authentication on Mobile Devices: Recent Progress and Remaining Challenges," in *IEEE Signal Processing Magazine*, vol. 33, no. 4, pp. 49-61, July 2016. [[PDF](#)]

- (a) What is *continuous authentication*? Why is it necessary?
 - (b) What are some of the other terms used in the literature in order to refer to continuous authentication?
 - (c) What are some of the limitations of *explicit* authentication mechanisms such as passwords and PINs?
 - (d) Describe some of the biometric attributes that can be used for continuous authentication.
 - (e) What are some of the *usability* and *security* issues related to the deployment of continuous authentication mechanisms on mobile devices?
2. [10 points] Consider an experiment in which you are provided the face images of 10 subjects. The number of images collected from each subject is tabulated below:

Subject Number	Number of Images
001	4
002	8
003	1
004	2
005	9
006	7
007	11
008	6
009	5
010	3

Based on these numbers, what is the number of genuine scores and the number of impostor scores that can be generated using a symmetric face matcher? Explain your answer.

3. [10 points] Describe in detail the differences between a *verification* system and an *identification* system. You must state at least 4 differences. In addition, describe 1 example for each system.
 4. [10 points] Use a webcam or a smartphone camera to capture 10 images of your face. The images must exhibit variations in facial pose (e.g., frontal face profile, side face profile), illumination (e.g., bright sunlight, low indoor lighting, partially illuminated face), expression (e.g., neutral, smiling, frowning), scale (e.g., close-up, at-an-arms-length), etc. Include these images in your report and describe, from your perspective, what type of facial features may be useful to successfully match these images. Justify your choice of features.
 5. You are given a set of scores corresponding to two modalities/matchers - fingerprint and hand. The fingerprint scores are *similarity-based*, while the hand scores are *distance-based*, i.e., *dissimilarity-based*. The set of scores can be accessed [here](#).
 - (a) [2 points] How many genuine and impostor scores are available for the fingerprint matcher and the hand matcher?
 - (b) [4 points] What are the maximum and minimum scores generated by each matcher?
 - (c) [9 points] Write a program that inputs a threshold value, η , for each matcher, the set of genuine scores, and the set of impostor scores, and outputs the False Match Rate (FMR) and False Non-match Rate (FNMR) at that threshold. Use this program to compute the FMR and FNMR for the following scenarios:
 - i. Fingerprint Matcher: $\eta = 45$
 - ii. Hand Matcher: $\eta = 45$
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