Homework 2

CSE 402: Biometrics and Pattern Recognition
Instructor: Dr. Arun Ross
Due Date: October 17, 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. [10 points] Consider a scenario wherein a fingerprint-based biometric system is installed in a grocery store in East Lansing. Assume that shoppers have the option of enrolling into the system. This would allow them to render payment at the checkout register by merely placing their index finger on a fingerprint sensor and typing in a 4-digit PIN. After successfully verifying the shopper's identity, the system would then connect to their bank account and debit the amount of the purchase. Based on the terminology developed in class, explain how you would characterize this biometric system (see Section 1.5.1 in the text book). You must justify your answer with a **detailed** explanation.

2. [10 points] (a) What is the main difference between closed-set identification and open-set identification? (b) Consider a watch-list application in an airport where a passenger's biometric data is used to determine if they are present in a watch-list or not. Is this an example of open-set or closed-set identification? Justify your answer.

3. [10 points] A set of 10 fingerprint images may be accessed here. Based on visual examination, determine the class of each of the 10 fingerprints. **Justify your answer.** (For each fingerprint, include the image along with a clear annotation explaining how the class was determined.)

4. [10 points] Briefly describe the following terms: (a) Latent Fingerprints; (b) Volar Pads; (c) Orientation Field; (d) Level 3 Features; (e) Delta

5. [10 points] According to the article *Fingerprint Matching* by Jain et al., describe some of the challenges that exist in fingerprint recognition. **You must explain each challenge in detail.**

6. [10 points] Collect a few fingerprint images using your smartphone *camera* for this problem.

   (a) Use any image editing program (e.g., PhotoShop, Gimp, Matlab, etc.) to manually crop out and obtain one image each of the following 8 fingers: left and right index fingers, left and right middle fingers, left and right ring fingers, and left and right pinky fingers.

   (b) Use any image editing program to improve the "quality" of each image so that the ridges and valleys are clearly discernible (e.g., you can perform histogram equalization, change image contrast and brightness, apply gamma correction, etc.). Note: You do not have to write a program to enhance quality - the adjustment

can be done using existing image editing tools. But you are also allowed to write a program to improve the quality.

(c) What type of image processing operations did you conduct to improve the quality of each image?

(d) Manually mark at least 5 minutiae points in each of the 8 processed images. Also, mark the core and delta points, if present. Include these images along with the marked points in your report.
