1	Consider a scenario wherein a hand geometry-based biometric system is installed in the bookstore at University of Florida. Assume that shoppers have the option of enrolling into the system which would allow them to render payment at the checkout register by placing their right hand on a scanner and typing in a 4 digit PIN. The purpose of the biometric system would be to access and update the customer's bank account. Based on the terminology developed in class, how would you classify this biometric system? Justify your answer.
Solution	Based on the details provided, the nature of biometric system is as follows: • **Multi-factor Authentication:** In order to be authenticated, user has to provide hand geometry trait as well as secured 4-digit PIN linked to his bank account. In this case, more than one factor is used to authenticate the user. Hence, this biometric system is Multi-factor Authentication system. • **Co-operative:** In this scenario, user will actively cooperate with the staff, as his interest is to get correctly identified. Hence, this biometric system is Co-operative system. • **Overt:** In this case, user has sound knowledge about providing his/her biometric trait. Hence, this biometric system is Overt system. • **Habituated:** In the initial training period, user will be trained to use this biometric system. But, after this period, user will be in position to indigenously operate this biometric system. This use case is similar to ATM usage. Hence, this biometric system is Habituated system. • **Attended Enrollment:** The process of enrollment will require external guidance from bookstore staff. • **Closed:** Enough information is not mentioned in provided scenario. System can be an open system, if the same biometric traits are used by bank as well as bookstore. As this information is not known, I assume this system to be an Closed system.
2	Define the following terms with appropriate examples; (a) Intra-class variability; (b) Inter-class similarity; (c) Functionality creep.

Solution	• **Intra-class variability:** Intra-class variability is term defined for variations in biometric traits, captured from the same person at different environmental conditions. Here, different environmental conditions imply that multiple probes are collected at different time intervals. This term is linked to False Reject Rate (FRR) of biometric system. Consider an example of providing fingerprints at regular interval of time. During each fingerprint collection, there will be variations in probes collected, as there might be differences in factors such as finger pressure and finger alignment. These variations in collected probes are termed as “Intra-class variability”. • **Inter-class similarity:** Inter-class similarity is term defined for similarity in biometric traits collected from different users at same/different environmental conditions. This term is linked to False Accept Rate (FAR) of biometric system. Consider an example of twins. Their is high similarity between facial image of twins. This can led to false positives. This similarity should be low for minimum FAR of system. • **Functional Creep:** Functional Creep is negative term articulated for intentional use of biometric data for application other than its original defined application. Consider an example, wherein the fingerprint data of user to be used for bank authentication application. But, this data can be used for finding his/her health records. This type of intentional breach on biometric data without informing its user is called “Functional Creep”.
3	Case Study

Solution

Case Study Topic: Biometric system at Visa Application Centre(VAC).

As I am international student, I have gone through the process of visa application and I can thoroughly comment on biometric system used during this process, which is discussed below.

- **Classification of system:**

The biometric system at VAC can be classified as Multi-factor (Passport is used along with biometric traits), Cooperative (VAC staff helps to probe biometric traits of user), Overt (User has to personally provide his biometric trait), Attended Enrollment (Biometric trait is captured in presence of VAC staff), Un-habituated (We have infrequent trips to VAC) and Closed (Captured biometric data is highly secured).

- **Biometric Traits:**

The biometric traits used by VAC are Face and Fingerprint. Although, only fingerprints are used to authenticate, face images are captured and stored in their database for additional security. High quality Image of face is captured using DSLR camera. Fingerprints as well as palm prints are captured by high quality sensor.

- **Operation:**

Firstly, user has to visit VAC to provide his biometric traits (Fingerprints and Face Image) called as “Enrollment Phase”. High quality images are captured of both hand fingers and face. Also, passport is scanned and barcode on passport is captured and details are stored in database.

On day of Visa Interview, to authenticate user, person has to provide his fingerprints which are in-turn matched with fingerprints captured during enrollment. Manual authentication by using passport is carried out as well. Actually, the passport is used to retrieve personal details filled by user during filling his/her visa application form.

The captured fingerprints are also used by airport authority to authenticate user at port of entry.

- **Target Population:**

The target population are people traveling abroad. Although, the actual number of people using this biometric system is less, this biometric system is efficiently used in such applications.

- **Use of biometric solution:**

Border crossings and International travels must be safe and secured. The number of frauds can be minimized by using such biometric solutions. There are various uses of captured fingerprints. Captured fingerprints can be used to authenticate person during his abroad visits. These can also be used in negative identification. Due to various such pros, this biometric system is incorporated at VAC.