5-2 Milestone: Enhancement 3- Databases

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Briefly describe the artifact. What is it? When was it created?

  The artifact I have chosen to make all my enhancements to and in this module, enhancements in the area of Databases is an Android mobile application developed at SNHU in the CS360 class, which was centered around Mobile Architecture and Programming. The intent of the application was to track inventory items, with the app centered around having a main data table visible to the user and give the user the ability to perform CRUD (Create, Read, Update, Delete) functions within the application, altering the data in the database. An additional requirement of this application was to send an SMS notification to the user's phone number when any inventory item in the database reached a stock level of zero. This application was created in 2024 for the course and was progressively built with robust planning, User Interface design, and coding functionality into the application with Java.

Justify the inclusion of the artifact in your ePortfolio. Why did you select this item? What specific components of the artifact showcase your skills and abilities in databases? How was the artifact improved?

  This artifact was selected because the project offered a complexity level suitable for showcasing in a portfolio but was still rudimentary enough to make worthwhile enhancements. It is also unique in the sense that I will be able to perform all three areas of enhancement on a single artifact and continue to produce a better quality product throughout the duration of the course. This was also my first experience creating something full stack in nature, creating an application that connected the presentation layer to a backend database. While the artifact was fully functioning and met all the original requirements, I chose to enhance the artifact I the area of databases. I changed the database itself and the way that the application interacts with the database.

The artifact was improved by removing the old database, which was SQLite and native to Android and implementing a NoSQL Firestore database from Google. This switch enabled the data to be stored in the cloud, which enhances real time inventory tracking for multiple users on the application. Utilizing NoSQL offers more schema flexibility to meet the use case of the user, offering more scalability (MongoDB). Moving the data storage from local to the device as it was in the artifact to cloud based was critical in making the application more scalable to meet a wider variety of user needs. In addition to making the application more scalable, this enhancement also offered me the opportunity to increase the security in the application. Previously, the passwords were stored as strings, which is incredibly unsecure and not a best practice. I was able to add a layer of encryption to passwords being stored in the database using AES/GCM, ensuring both confidentiality and integrity through authenticated encryption before storing them in Firestore. The encryption key is securely managed using Android's Keystore system, preventing unauthorized access to sensitive credentials.

Migrating the database from native SQLite for Android to a NoSQL Firestore database showcases several key skills in mobile and backend development. It shows proficiency in database management, including understanding relational and non-relational paradigms, and the ability to design scalable and flexible data structures suitable for cloud-based applications. The enhancement shows skills in Firebase integration, authentication of data, and real-time data syncing. Working with Firestore encourages the adoption of modern cloud-based architecture, enhancing skills in cloud computing and mobile-backend integration, which are important to use in Android applications. The added layer of encryption also shows skills in cryptography and developing a security mindset with projects.

Did you meet the course outcomes you planned to meet with this enhancement in Module One? Do you have any updates to your outcome-coverage plans?

The course outcomes from the syllabus that I intended to meet with this enhancement were outcomes 1-4. With this enhancement, I found that I was able to meet all of the course outcomes by improving the security in the application with data encryption. Outcome 1 was demonstrated by creating a more collaborative environment with this database enhancement. The enhancement allowed the application to reach more users and be more collaborative by utilizing the cloud-based database from Firestore. Outcome 2 was achieved by providing clear comments and documentation in the code. Additionally, clearly documenting my enhancement plan in module 1 as well as speaking to it in the code review demonstrates delivering professional quality communications. Outcome 3 involving weighing trade-offs and evaluating computing solutions. In choosing the direction I wanted to go in with the database enhancement, I was forced to weigh these decisions and understand the cost/benefit analysis in picking a cloud-based database. Outcome 4 involves using well founded and innovative techniques in computing practices; by modernizing the database for this application, I was able to demonstrate this course outcome. Using a Firestore database may not be a revolutionary concept, but based on my knowledge level and exposure to cloud-based databases, it was new and innovative experience for me. While not initially intended, I could not ignore the security issues that I saw with the original application in the code review. By enhancing the data confidentiality through encryption, I was able to also demonstrate course outcome 5 and demonstrate a security mindset, anticipating adversarial exploits in software.

At this point in the enhancements, I am content with how the course outcomes have been covered through the enhancements. Prior to publishing the application to my ePortfolio, I intend on polishing each of the enhancements further, developing a more professional product. In doing so, all outcomes will be covered and very evident in through the ePortfolio.

Reflect on the process of enhancing and modifying the artifact. What did you learn as you were creating it and improving it? What challenges did you face?

Enhancing and modifying the artifact provided insights into database migration and application security. Migrating the database from SQLite to Firestore turned out to be simpler than expected, as the instructions from Google for implementing the database into the application were very easy to follow. Securing the app with password encryption presented a greater challenge. Implementing AES/GCM/NoPadding encryption required management of encryption keys to prevent vulnerabilities, and integrating the Android Keystore System added complexity in ensuring that keys were securely stored and accessed. Debugging issues related to key storage, retrieval, and encryption failures required refreshing my knowledge of cryptographic principles and Android security APIs. Through this process, I gained a deeper understanding of secure data handling, cryptographic key management, and the importance of strong security practices in mobile applications. Additionally, in testing, I realized that I needed to see how the application worked with a larger amount of data. This required writing a script to seed the database with my mock JSON data and seeding the database with node. This was another part of the enhancement where I had to look up documentation and recall prior coursework from CS 465, Full-Stack Development.

References

MongoDB. (n.d.). *Understanding sql vs nosql databases.*
   https://www.mongodb.com/resources/basics/databases/nosql-explained/nosql-vs-sql

Southern New Hampshire University. (n.d). *Undergraduate course syllabus- CS 499: computer
   science capstone.*