Patrick Quinn

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Computer Science Final Project Milestone 3 Narrative

The artifact I've enhanced is a DatabaseHelper class implemented in Kotlin for an Android weight tracking application. Originally created as part of a mobile development project, this class manages SQLite database operations for user authentication and weight tracking. While the initial version provided basic functionality, it lacked robust security measures and optimization features that are crucial for a production-ready application.

I selected this artifact because it effectively demonstrates my ability to implement secure and efficient data structures and algorithms in a real-world application. The enhancements I've made showcase several critical improvements in security architecture, data structure design, and algorithm implementation. In terms of security, I implemented secure password hashing using SHA-256 with unique salts for each user, added comprehensive input validation using regex patterns, and protected against SQL injection through parameterized queries. I also developed a secure password migration strategy for database upgrades; ensuring existing user data remained protected during system updates.

The data structure design received significant optimization through the addition of database indices for improved query performance, implementation of constraints to maintain data integrity, and the introduction of cascade deletion for related records. I also added proper data validation boundaries for weight entries, ensuring the database maintains consistency and reliability. The algorithm implementation saw improvements through the development of secure password hashing with salt generation, creation of efficient database migration procedures, implementation of thread-safe cursor handling using Kotlin's use function, and the addition of robust error handling with custom exceptions.

These enhancements successfully addressed the planned course outcomes in both algorithm design and data structure knowledge. The work demonstrated advanced knowledge of cryptographic algorithms, efficient data migration strategies, and optimized database queries with proper indexing. The enhanced database schema design includes additional security features, proper data constraints and relationships, and efficient indexing structures for improved performance.

The process of enhancing this artifact provided invaluable learning experiences and presented several interesting challenges. I deepened my understanding of cryptographic best practices in mobile applications, database optimization techniques, secure data migration strategies, and input validation methods. I acquired technical skills in implementing salted password hashing, database indexing strategies, efficient cursor handling in Kotlin, and exception handling best practices.

Throughout the enhancement process, I faced and overcame several technical challenges. Implementing secure password migration without data loss required careful planning and testing. Balancing security with performance demanded thoughtful consideration of tradeoffs, while ensuring backward compatibility and managing database versioning required systematic problem-solving approaches. I developed comprehensive testing strategies for security features, created efficient database upgrade procedures, implemented thorough error handling, and optimized query performance without compromising security.

This enhancement demonstrates my ability to take an existing codebase and improve it with industry-standard security practices while maintaining clean, efficient, and maintainable code. The project showcases my skills in both algorithmic thinking and practical implementation of secure data structures. The enhanced version provides a robust foundation for secure user data management while maintaining high performance and code quality, reflecting my commitment to creating secure, efficient, and well-structured software solutions.

Looking back at the enhancement process, I'm particularly proud of how the improvements address real-world security concerns while maintaining the application's usability and performance. The experience has strengthened my understanding of secure database management and reinforced the importance of considering both security and efficiency in software development. This project serves as a strong example of my ability to analyze, enhance, and optimize existing code while implementing industry best practices in security and data management.