

Enhancement Three: Databases

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CS-499: Milestone 5-2

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Enhancement Three: Databases

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

For this enhancement, I selected the Investment App Program from CS410: Software Reverse Engineering. This artifact was the final project of that course and was created in February 2025. The original artifact was a program that I needed to reverse from binary to C++ and then identify and correct security vulnerabilities. The program originally displayed a list of hardcoded clients and their investment service selections.

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 software development? How was the artifact improved?

I selected this artifact for my enhancement because it offered the opportunity to demonstrate implementing a program that utilizes a database and common security principles such as authentication and role-based access control (RBAC). The original artifact had several security vulnerabilities that could be addressed through the implementation of a database and other secure design principles. It utilized hardcoded customer data and passwords, meaning that it lacked persistent data storage and secure user authentication. These limitations made the program insecure, difficult to maintain, and not in anyway scalable.

The enhanced version, which I ultimately chose to write in Python instead of C++, integrates MongoDB for persistent storage, bcrypt for secure password hashing and salting, and RBAC to enforce user access and permissions. The enhanced design better reflects modern development practices and demonstrates my skills in integrating a database and applying secure coding principles.

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?

Yes, I met the course outcomes I originally planned to address with this enhancement. Specifically:

[CS499-02] *Design, develop, and deliver professional-quality oral, written, and visual communications that are coherent, technically sound, and appropriately adapted to specific audiences and contexts.*

I improved the quality and readability of the original code and used descriptive comments and consistent documentation throughout the codebase.

[CS499-03] *Design and evaluate computing solutions that solve a given problem using algorithmic principles and computer science practices and standards appropriate to its solution while managing the trade-offs involved in design choices.*

I applied input validation, error handling, and logical branching via a dynamic menu based on user roles to securely handle user interactions.

[CS499-04] *Demonstrate an ability to use well-founded and innovative techniques, skills, and tools in computing practices for the purpose of implementing computer solutions that deliver value and accomplish industry-specific goals.*

In this enhancement, I implemented modern tools such as MongoDB and bcrypt to deliver solutions that align with industry best practices.

[CS499-05] *Develop a security mindset that anticipates adversarial exploits in software architecture and designs to expose potential vulnerabilities, mitigate design flaws, and ensure privacy and enhanced security of data and resources.*

The original artifact had several unaddressed security vulnerabilities—such as hardcoded plaintext passwords and user data, along with a lack of input validation. By implementing hashed and salted passwords, enforcing authentication and RBAC, and protecting data through persistent, secure changes, I demonstrated a security mindset that ensures the privacy and protection of sensitive information.

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?

I had originally intended to enhance the artifact using C++. However, after encountering several challenges with the necessary drivers required for C++ to utilize MongoDB on my machine, I decided to save time by either switching to a different database format (like SQL) or converting the artifact to another language. I opted to convert the program to Python due to its seamless integration with MongoDB and bcrypt, two tools I had already planned to use.

I also had to think carefully about how to implement a menu that would dynamically display different options based on user roles, rather than writing a separate menu for each one. Throughout the process, I learned a great deal about how C++ links to external drivers and dependencies. I also gained a deeper understanding of scalable design principles and how to apply best practices to create more maintainable and secure software.