**Milestone Four: Database Artifact Enhancement**

**Joshua Donnelly**  
**CS 499 – Computer Science Capstone**

For my ePortfolio, I selected a **reverse engineering project** that I completed in a previous course. This project involved analyzing an existing software system, understanding its database interactions, and reconstructing its design and functionality. The primary goal of this reverse engineering process was to document the system comprehensively, identify security vulnerabilities, and suggest enhancements to improve performance and maintainability. The project was originally created as part of a course focusing on **software security, system analysis, and database structures**, requiring the deconstruction of a compiled application to analyze its data flow and database interactions. The artifact includes **code analysis, database schema documentation, and recommendations for optimization and security improvements**.

I selected this artifact for my ePortfolio because it **demonstrates my proficiency in system analysis, database structures, and secure software design**. Reverse engineering is a valuable skill in cybersecurity and software maintenance, and this project highlights my ability to analyze and document an existing system’s database structure, identify security vulnerabilities, optimize performance, and apply industry-standard reverse engineering tools. By including this project in my ePortfolio, I showcase my **technical expertise in databases, software architecture analysis, and security**, all of which are critical skills for roles involving software maintenance, penetration testing, and secure system design.

As part of Milestone Four, I implemented several key **enhancements** to improve the artifact. First, I focused on **database optimization**, improving SQL query efficiency, normalizing the database schema to eliminate unnecessary data duplication, and adding indexing to enhance performance in large-scale data processing. Second, I introduced **security enhancements** by identifying and mitigating potential SQL injection vulnerabilities, strengthening authentication mechanisms to prevent unauthorized access, and implementing parameterized queries to enhance database security. Finally, I worked on **improving documentation and code readability** by refactoring the code for better maintainability, expanding the documentation with flow diagrams illustrating database interactions, and clearly outlining how data is processed, stored, and retrieved within the system. These enhancements demonstrate my ability to **critically analyze and improve existing software systems**, particularly in **database management, performance optimization, and security**.

This enhancement aligns with several **Computer Science program outcomes**. In the area of **data structures and algorithms**, I improved database queries and indexing to ensure efficient data retrieval and optimized system performance by reducing query execution time. My work also aligns with **software engineering and database best practices**, as I applied **reverse engineering techniques** to analyze and reconstruct database interactions while implementing industry standards for secure database access. Additionally, my enhancements reflect a **security mindset**, as I strengthened authentication mechanisms, introduced input validation, and mitigated SQL injection risks to improve the overall security of the system.

Throughout this enhancement process, I gained valuable insights into **database security, optimization techniques, and reverse engineering methodologies**. I learned how inefficient database queries impact performance and explored techniques such as indexing and normalization to optimize them. Additionally, I reinforced my understanding of **secure coding practices**, ensuring that database interactions remain protected against common vulnerabilities. I also improved my documentation skills by effectively communicating complex system interactions through diagrams and structured explanations.

One of the biggest challenges I faced was **interpreting obfuscated database interactions in the original software system**. Reverse engineering required a **meticulous approach to analyzing decompiled code and reconstructing the original logic**. Ensuring that my **security enhancements did not introduce unintended side effects** was another key consideration throughout the improvement process.

This **reverse engineering project** highlights my expertise in **system analysis, database optimization, and secure software development**. By enhancing this artifact, I demonstrated my ability to **analyze existing systems, identify vulnerabilities, and implement effective solutions**. As I finalize my **ePortfolio**, I plan to incorporate additional feedback from my instructor to further refine the project and ensure that it meets industry standards. This artifact serves as a strong representation of my **technical skills, problem-solving abilities, and security-focused mindset**, making it a valuable addition to my professional portfolio.

As my next steps, I will **review instructor feedback** and make final refinements before publishing. Additionally, I will enhance **visual documentation** by adding diagrams illustrating database optimizations and prepare a **presentation-ready summary** of the project for potential employers. These improvements will ensure that my ePortfolio effectively showcases my skills and knowledge in database management and reverse engineering.