

Clint Monroe

CS 499 Computer Science Capstone

Southern New Hampshire University

24 November 2024

Enhancement Three: Databases

Narrative:

The artifact selected for this enhancement is an interactive animal shelter management dashboard, initially created during a previous course as a Python-based application using Dash. For the capstone project, I transitioned this application to a full-stack architecture, utilizing React for the frontend, FastAPI for the backend, and SQLite for the database. This artifact showcases my skills in database management, particularly in optimizing data storage, improving security, and enhancing performance. The database layer has been upgraded to include SQLAlchemy ORM for efficient database interactions, Pydantic models for robust data validation, and Firebase for user authentication, ensuring data privacy and secure access. These enhancements demonstrate my ability to integrate modern technologies and best practices to create scalable and maintainable database solutions.

I selected this artifact for my ePortfolio because it highlights my strengths in database design and management, an essential aspect of professional computing solutions. The artifact showcases my ability to transition from a simpler, script-based database to a fully normalized SQLite database using SQLAlchemy. Key enhancements include optimizing queries for faster data retrieval, implementing rate limiting with SlowAPI to protect against abuse, and designing a user management system that integrates secure registration and authentication through Firebase. These improvements align with industry standards and reflect my proficiency in developing

efficient, secure, and user-centric solutions. By offloading sorting and filtering operations to the database layer, I demonstrated my ability to optimize backend functionality and reduce application response times. These components collectively represent a comprehensive demonstration of my database and software engineering skills.

This enhancement aligns with the course outcomes established in Module One, particularly in employing innovative tools and techniques to create computing solutions that deliver value. The use of SQLAlchemy and Pydantic demonstrates my ability to implement industry-standard practices, while the integration of Firebase and SlowAPI reflects a security mindset that anticipates and mitigates potential vulnerabilities. Additionally, the structured database interactions and secure API endpoints support collaborative environments by ensuring the application is scalable and adaptable for future development. At this stage, I remain on track to meet all planned course outcomes by the project's conclusion, with no updates required to my outcome-coverage plans.

Enhancing this artifact deepened my understanding of database normalization, security, and the importance of efficient data handling. One of the key challenges I faced was debugging ORM-related issues, such as managing relationships between tables and ensuring data validation workflows aligned seamlessly across the database and API layers. I also learned the importance of thoughtful schema design, which helped reduce redundancy and improve query performance. Integrating Firebase for user authentication and Pydantic for data validation further strengthened my understanding of securing web applications. These challenges and solutions reinforced the value of iterative development and rigorous testing, particularly when implementing significant architectural changes. This process has prepared me to finalize the artifact during the upcoming sprint, ensuring it is polished and production-ready for inclusion in my ePortfolio.

Sprint Update

- **Sprint 1: Project Initialization & Environment Setup** – The initial sprint was successful, though I encountered challenges such as needing to restart the project after discovering that create-react-app was deprecated in favor of Vite. Despite these hurdles, all objectives were met, laying a solid foundation for future work.
- **Sprint 2: Core Feature Development** – This sprint exceeded expectations, as I successfully implemented all planned visualizations (table, chart, and map) while also enhancing the backend with PUT and DELETE operations and extending the frontend to support adding, editing, and deleting database records. These updates represent a significant improvement, making the app more functional and accessible.
- **Sprint 3: Data Optimization & Security** – This sprint focused on implementing data validation using Pydantic, adding rate limiting with SlowAPI, and integrating Firebase for user registration and authentication. These updates enhanced the application's data handling, security, and user management capabilities, aligning with the sprint's goals for optimization and security. All planned objectives were successfully completed, providing a secure and reliable foundation for the final sprint.
- **Sprint 4: Backlog & Polish** – With no remaining backlog items, this sprint will focus on reviewing feedback from previous submissions to identify opportunities for further improvements. The primary objective is to thoroughly test the application and ensure a smooth deployment, making it ready for use in the capstone evaluation. This final sprint aims to deliver a polished, production-ready application that aligns with all project goals.