CS-499: Computer Science Capstone

1 December 2024

5-2 Milestone Four: Enhancement Three: Databases

The artifact is a **Database Management System (DBMS)** project that involves designing and implementing a relational database. It was created in **2024** as part of a course module focused on database design and management. The project includes creating database schemas, implementing relationships between tables, writing SQL queries for data retrieval and manipulation, and ensuring data integrity and security.

I selected this artifact for my ePortfolio because it demonstrates critical skills in **database design, management, and query optimization**, which are essential for any computer science professional. This project highlights the following skills and abilities:

* **Database Schema Design**: The artifact includes a well-structured schema with normalized tables, appropriate keys, and relationships that ensure data consistency and minimize redundancy.
* **SQL Query Proficiency**: It features a variety of complex SQL queries that showcase my ability to extract, manipulate, and manage data effectively.
* **Data Integrity and Security**: The project incorporates constraints such as primary and foreign keys, as well as user permissions, ensuring robust data integrity and controlled access.
* **Optimization**: I optimized the database structure and queries for better performance, particularly for handling large datasets and ensuring quick query execution.

The artifact was improved by refining the schema design to achieve higher normalization levels and enhancing query performance through indexing and query optimization techniques. Additionally, I implemented advanced security features, such as role-based access control, to align with best practices in database security.

Yes, the artifact meets the course outcomes I planned to address, particularly:

* **Outcome 3**: *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.*

By designing and implementing an optimized database schema, I effectively addressed this outcome. The project showcases my ability to make trade-offs between performance, scalability, and data consistency in database design.

* **Outcome 4**: *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.*

This outcome is reflected in the practical application of database management tools and techniques, as well as the project’s alignment with industry standards for data management.

I have no updates to my outcome-coverage plans for this artifact, as it aligns well with the The process of enhancing and modifying the DBMS project provided several valuable learning experiences:

* **Normalization and Schema Design**: I gained a deeper understanding of normalization principles and the importance of a well-structured schema for reducing redundancy and ensuring data consistency.
* **Query Optimization**: Through testing and refining SQL queries, I learned how indexing, join strategies, and query structure impact performance, especially for large datasets.
* **Security Best Practices**: Implementing role-based access control and user permissions taught me the importance of securing data and aligning with industry standards for database security.
* **Trade-offs in Design**: I experienced the challenges of balancing performance with data integrity and security, which required thoughtful trade-offs in schema design and query implementation.

One of the main challenges was optimizing the database to handle large datasets efficiently without compromising on data integrity or security. Achieving this required experimenting with indexing strategies and adjusting queries to ensure quick execution while maintaining accuracy.

Overall, the process of creating and enhancing this artifact reinforced my skills in database management and taught me how to build scalable, secure, and efficient databases tailored to real-world applications.