Milestone Four Narrative: Databases Enhancement

Artifact Description

The artifact I selected for this milestone is the Animal Shelter Database Management System, which I created during the CS-340 course in February 2024. This system is designed to manage records for an animal shelter, including performing CRUD (Create, Read, Update, Delete) operations on animal data stored in a MongoDB database. It was originally built to handle various queries, such as finding animals based on specific criteria, updating records, and removing outdated entries. The database stores relevant information like animal IDs, breeds, names, and location data.

Justification for Inclusion in the ePortfolio

I selected this artifact for my ePortfolio because it demonstrates my proficiency in database management and showcases my ability to design and optimize database interactions using MongoDB, a NoSQL database. This project highlights several important database concepts:

* CRUD Operations: The project includes well-structured methods for creating, reading, updating, and deleting documents in the database. These operations are fundamental for managing real-world data in any application.
* Database Querying: The artifact shows my understanding of querying techniques to retrieve specific sets of data from the database based on user input or criteria.
* Data Handling and Security: I incorporated proper error handling and validation to ensure that invalid or incomplete data cannot corrupt the database. This reflects my commitment to building secure and reliable systems.

The enhancement I made to the artifact further strengthens its relevance. I improved memory management by integrating smart pointers and optimized data retrieval and query methods to ensure faster response times, especially when handling large datasets. These improvements make the artifact a solid demonstration of my skills in working with real-world databases.

Course Outcomes Achieved

With the enhancements made to this artifact, I have achieved several course outcomes:

* Outcome 3 (Algorithm Design and Evaluation): By optimizing the data retrieval process, I improved the overall efficiency of the system’s algorithmic components.
* Outcome 4 (Innovative Techniques in Software Development): Implementing memory management improvements and optimizing the system’s performance reflect my ability to use innovative techniques to meet industry-specific goals.
* Outcome 5 (Security Mindset): Through data validation and error handling, I demonstrated my focus on ensuring data security and integrity within the database.

These outcomes show that I have developed a strong foundation in designing reliable, efficient, and secure database solutions.

Process of Enhancing and Modifying the Artifact

The enhancement process for this artifact involved several key tasks:

1. Improving Query Performance: Initially, the system was able to handle basic queries, but it was not optimized for performance. By indexing certain fields and fine-tuning the query logic, I was able to reduce the time complexity of common queries, especially those involving filtering by animal breed or location.
2. Memory Management: The original system used raw MongoDB cursors to iterate over results. To improve memory safety, I refactored the code to use smart pointers, ensuring that resources are automatically managed and preventing potential memory leaks.
3. Error Handling and Validation: I added additional validation checks to ensure that all inputs are sanitized before interacting with the database. For example, before inserting a new animal record, the system verifies that all required fields are present and valid.

Challenges:

* One challenge I faced was ensuring that the changes to query optimization didn’t affect the correctness of the results. Testing different scenarios to confirm that the system returned accurate results after optimization was critical.
* Another challenge was implementing memory management in a way that didn’t introduce unnecessary complexity. I had to refactor parts of the code carefully to ensure the system remained maintainable.

Through this enhancement process, I gained a deeper understanding of how small changes in database queries and memory management can significantly affect overall system performance. I also learned the importance of balancing performance improvements with code simplicity and maintainability.

Status Checkpoints for All Categories

| Checkpoint | Software Design and Engineering | Algorithms and Data Structures | Databases |
| --- | --- | --- | --- |
| Name of Artifact Used | Contact Management System | CSV Parser and Sorting Program | Animal Shelter Database Management System |
| Status of Initial Enhancement | Completed CRUD and error handling | Optimized sorting algorithms, memory management | Improved query performance and memory management |
| Submission Status | Submitted for review | Submitted for review | Submitted for review |
| Status of Final Enhancement | Pending final adjustments | Ready for final testing | Final testing and validation in progress |
| Uploaded to ePortfolio | Not yet uploaded | Not yet uploaded | Not yet uploaded |
| Status of Finalized ePortfolio | In progress—awaiting final revisions | Awaiting final feedback | Preparing for final submission |

This narrative and status update provide a detailed overview of the Animal Shelter Database Management System and the enhancements made to improve its performance and security. Through this milestone, I have demonstrated my proficiency in database management and optimization, which are critical for any computer science professional.

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