**4-2 Milestone Three: Enhancement Two: Algorithms and Data Structure**

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**Milestone Three Narrative: Enhanced Contact Service**

**Artifact Description**

The artifact I selected for enhancement is a Java-based ContactService application that manages a collection of contact objects. This artifact was originally created during an earlier course in the computer science program to demonstrate object-oriented principles and basic CRUD operations using a linear data structure (ArrayList). The service included functionality to add, retrieve, update, and delete contact records, as well as test cases for each operation.

**Justification for Inclusion in ePortfolio**

I included this artifact in my ePortfolio because it directly aligns with the Computer Science program outcome related to data structures and algorithms. This project originally used a linear search approach for operations like lookup and delete, which is not scalable for large datasets. For this milestone, I enhanced the artifact by replacing the ArrayList with a HashMap, improving lookup efficiency from O(n) to O(1). Additionally, I implemented a new feature: an autocompleteSearch function that returns a list of contacts whose first names match a given prefix. This simulates real-world usability seen in contact or messaging apps and demonstrates my ability to apply algorithmic thinking to practical scenarios.

These enhancements showcase my ability to design efficient data structures, implement algorithmic solutions to problems, and integrate additional functionality while preserving code readability and modularity. I also updated the corresponding unit test class (ContactServiceTest) to reflect these changes and verify the new autocompleteSearch functionality.

**Course Outcomes Achieved**

This artifact supports the following program outcome:

**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.

**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.

In Module One, I planned to demonstrate competency in using appropriate data structures and improving algorithmic performance, and I believe this enhancement has achieved that goal. By migrating to a HashMap, I demonstrated my understanding of algorithmic efficiency. Adding the autocompleteSearch feature showcased how to implement partial matching logic that balances performance and functionality. At this point, I have no changes to the outcome-coverage plans.

**Reflection on the Enhancement Process**

While enhancing this artifact, I deepened my understanding of how data structures impact application performance. Transitioning from a List to a Map involved rethinking how data is accessed and modified, especially for operations like update and delete, which are inherently more efficient with hashing.

The most valuable learning occurred when implementing and testing the autocomplete feature. I had to consider string matching techniques, iteration over map values, and returning dynamic result sets. Additionally, I improved my unit testing skills by writing test cases that assert correct behavior of the new feature and confirm that the existing functionality remained intact.

A notable challenge was ensuring all parts of the codebase—including test files—were updated consistently with the data structure change. Because Java is statically typed, method signatures and test assertions had to be carefully rewritten to accommodate the Map<String, Contact> structure. This required attention to detail and a methodical approach to testing and validation.

**Summary**

This milestone allowed me to demonstrate tangible progress toward algorithmic proficiency and software design skills. By enhancing the efficiency and functionality of a real-world-style Java service, I reinforced best practices in data handling, user-centered design (autocomplete), and robust test coverage. This artifact is a strong representation of my readiness to apply computer science principles to industry-relevant problems.