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11/24/2024

### **Artifact Description and Selection Justification**

The artifact I selected for inclusion in my ePortfolio is a **custom implementation of a sorting algorithm library** originally created during a prior course project. This library includes several sorting techniques, such as QuickSort, MergeSort, and BubbleSort, written in Python. It was initially developed as part of an algorithms and data structures module to demonstrate my understanding of fundamental sorting principles and the trade-offs between time and space complexity.

I chose this artifact because it directly showcases my proficiency in algorithms and data structures, which is a core outcome of the Computer Science program. This artifact demonstrates the practical application of algorithmic design, complexity analysis, and data manipulation. The enhancements made further highlight my ability to identify inefficiencies, refactor existing code, and incorporate advanced concepts.

### **Enhancements and Skills Demonstrated**

The enhancements I applied to this artifact include:

1. **Improved Efficiency**: Optimized the QuickSort implementation by switching to an insertion sort for small subarrays, reducing overhead in practical use cases.
2. **Added Flexibility**: Generalized the sorting functions to support custom comparison operators, making the library applicable to a broader range of datasets.
3. **Enhanced Readability and Documentation**: Refactored the code to follow Pythonic best practices, added type hints, and included detailed docstrings to explain each function's purpose and usage.
4. **Unit Tests and Benchmarking**: Integrated unit tests using unittest and benchmarked the algorithms using large datasets to compare performance improvements.
5. **Error Handling**: Implemented robust error-checking mechanisms to handle invalid input gracefully, ensuring reliability.

These enhancements demonstrate my skills in writing efficient, maintainable, and scalable algorithms. They also showcase my ability to analyze existing code critically and apply principles of software engineering to improve quality.

### **Alignment with Course Outcomes**

The enhancements align with several Computer Science program outcomes:

* **Algorithms and Data Structures**: By optimizing and generalizing the sorting algorithms, I demonstrated my ability to design and evaluate computing solutions that solve complex problems effectively while considering trade-offs.
* **Software Engineering/Design**: The refactoring process and incorporation of unit testing reflect industry-standard practices for creating reliable, scalable software solutions.
* **Professional Communication**: The improved documentation and type hints demonstrate an ability to produce technically sound, professional-quality written communication.

### **Reflection on the Process**

The process of enhancing and modifying this artifact provided invaluable learning opportunities. One major lesson was the importance of benchmarking and profiling code before applying optimizations. For instance, profiling revealed that the original QuickSort implementation was inefficient for small datasets, guiding me to implement the hybrid approach.

Another critical takeaway was the significance of clear and consistent documentation. Refactoring the code and adding detailed docstrings not only made the artifact easier for others to understand but also improved my own understanding of the design choices I had made.

Challenges included balancing efficiency improvements with code readability. For example, while optimizing recursive calls in MergeSort, I had to ensure the changes did not compromise the algorithm's clarity. Additionally, learning and implementing unit testing frameworks added an extra layer of robustness to the artifact.

### **Justification for Inclusion**

This artifact represents a culmination of the skills I developed throughout the Computer Science program, specifically in algorithms, data structures, and software engineering. It highlights my ability to analyze and improve existing solutions, communicate technical concepts effectively, and apply industry best practices. Including this artifact in my ePortfolio demonstrates my readiness to contribute to complex projects in a professional setting.