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CS 499 Computer Science Capstone

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Milestone Three Narrative: Algorithms and Data Structure Enhancement

Artifact Description

The artifact I selected for this milestone is my **Grazioso Salvare Dashboard**, originally created in CS-340: Client/Server Development. This dashboard was built using Python, Dash, Plotly, and MongoDB to visualize animal shelter data and support rescue operations. The initial version provided basic filtering and visualization but lacked advanced data handling features. For Milestone Three, I revisited this artifact and enhanced it to demonstrate my skills in algorithms and data structures.

Justification for Inclusion

I chose this artifact because it represents a real-world application of data-driven decision making and showcases my ability to design and refine interactive dashboards. Specifically, the enhancements I implemented highlight my understanding of algorithmic principles:

- **Pagination**: Implemented to efficiently manage large datasets by loading only a subset of records at a time. This demonstrates optimization and memory-conscious design.

- **Sorting**: Enabled multi-column sorting, which applies algorithmic logic to dynamically reorder data based on user input.

- **Filtering**: Expanded radio button filters to query MongoDB with specific conditions, showcasing structured data retrieval.

- **Visualization Updates**: Improved the pie chart and map to dynamically reflect filtered and selected data, integrating algorithms with visual representation.

These improvements elevate the dashboard from a static display to an interactive, algorithmically enhanced tool. They directly showcase my ability to apply data structures (tables, records, queries) and algorithms (sorting, filtering, pagination) in a professional-quality artifact.

Course Outcomes Alignment

In Module One, I planned to demonstrate competency in the outcome:
"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."

I met this outcome by:

- Designing efficient pagination to balance usability and performance.

- Implementing sorting logic to improve data exploration.

- Managing trade-offs between native Dash functionality and custom callbacks, choosing solutions that were both effective and maintainable.

No updates are needed to my outcome-coverage plan; the enhancements align directly with my original goals.

Reflection on the Process

Enhancing this artifact taught me the importance of **clean code organization** and **iterative refinement**. Initially, my notebook was fragmented across multiple cells, which made the logic harder to follow. Consolidating the code into a structured layout improved readability and maintainability — a valuable lesson in professional software engineering.

I also learned how small algorithmic changes, such as enabling multi-column sorting or adding pagination, can significantly improve user experience and system efficiency. These enhancements required me to think critically about how data is stored, retrieved, and presented, reinforcing my understanding of both algorithms and data structures.

The main challenge I faced was environment setup and dependency management. Ensuring Dash, Plotly, and Dash Leaflet worked together smoothly required troubleshooting and persistence. Overcoming these obstacles strengthened my confidence in managing technical environments and debugging complex systems.

Conclusion

This milestone demonstrates my ability to enhance an existing artifact with algorithmic improvements that add real value. By implementing pagination, sorting, filtering, and visualization updates, I showcased my skills in algorithms and data structures while producing a professional-quality dashboard. This artifact is a strong addition to my ePortfolio because it reflects both technical expertise and growth in problem-solving, design trade-offs, and professional presentation.