Pushpa Laxman

Southern New Hampshire University

CS-499-19649-M01 Computer Science Capstone 2025

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

Neil Kalinowski  
05/31/2025

Q. Briefly describe the artifact. What is it? When was it created?

My name is Pushpa Laxman, and I will evaluate the code for Milestone Three as a part of my final project CS 499. This document presents a review and improvement of an artifact showcasing my understanding and abilities in algorithms and data structures. I will explain the functionality of the code, highlight potential areas for enhancement, and discuss how it has been refined to meet the course objectives and be prepared for my ePortfolio.

Selected Artifact: animal\_main.py, animal\_module.py

(CS 340 Project) Client/Server Development

This project demonstrates my ability to develop efficient algorithms according to industry standards.

A screenshot of a computer program

AI-generated content may be incorrect.

A screenshot of a computer program

AI-generated content may be incorrect.

A screenshot of a computer program

AI-generated content may be incorrect.

For my final project capstone, I will be examining the artifact CS 340 Client/ Server development project that will focus on the enhancements to the second category of the codebase, which covers Algorithms and Data Structures. This project was a full stack application were Model, View, and Controller development patterns were used to create an interactive web-based dashboard.

This artifact originates from my CS 340 (Client/Server Development) course, where I created an interactive and fully functional web-based training dashboard for an animal rescue organization. Grazioso Salvare focuses on finding dogs that are suitable candidates for their search-and-rescue training programs, aiming to train these dogs to help rescue both humans and other dogs in emergencies. It is essential to acknowledge that Grazioso Salvare has specific criteria in mind when selecting dogs for training. Utilizing existing data from Austin animal shelters, GS will be able to identify and classify the available dogs.

In this project, animal information will be accessible through a database for users to use. An animal database allows the creation, reading, updating, and deleting of animals from the database, also known as CRUD.

A screenshot of a computer

Description automatically generated

*A computer screen shot of a program code

Description automatically generated*

MongoDB provides an official Python driver called PyMongo. Using PyMongo, you can communicate with a MongoDB server in a variety of ways. The application facilitates querying, retrieving results, writing and deleting data, and running database commands. We built an interactive dashboard with filters for the Austin Animal Center Outcomes data (buttons, drop-downs).

Q. Justify the inclusion of the artifact in your ePortfolio. Why did you select this item? What specific components of the artifact showcase your skills and abilities in software development? How was the artifact improved?

A screenshot of a computer

Description automatically generated

I chose this artifact because it provides exposure to designing and implementing MongoDB databases, querying data effectively, and exploring and manipulating data using Python and the Jupyter environment. In addition, this project will establish user authentication for administrators and users, and access data via a MongoDB database, thereby gaining more hands-on experience in data modeling, indexing, and other advanced MongoDB concepts.

Authentication and authorization of a user are managed based on user credentials, and user interaction with modules and actions are accountable for CRUD operations. Through this project, I will gain experience modeling data effectively to optimize performance and create efficient queries, as well as how to use indexing to speed up data retrieval.

Currently, the application is modular enough. Modules are separated from the core codebase rather than being integrated into it, which makes the codebase more readable and easier to maintain. This project uses MongoDB as a database. Dash Plotly and Dash Leaflet comprise the view layer, and Python using Pymongo makes up the controller layer.

However, some areas needed improvement:

**Limitations**: Taking a closer look at the code, we see the Animal Shelter class, It is a monolithic architecture which lacks flexibility and scalability because it is based on one tightly coupled codebase. If you want to modify or change one function, you must modify the whole application. The process is time-consuming and resource intensive.

A screenshot of a computer code

AI-generated content may be incorrect.

A screenshot of a computer code

AI-generated content may be incorrect.

A screenshot of a computer

AI-generated content may be incorrect.

**Plan**: To address this, I plan to decompose the code into smaller, independent services. This will make each service independent and deployable separately. It is best to break up services into smaller, reusable, and maintainable units, such as modules, functions, and classes, in order to ensure that they can all be deployed separately. Work is still in progress and using methods that also allow us to access individual elements directly.

**Limitations**: As the animal class contains heterogeneous types of data, it makes more sense for applications that involve dynamic data and frequent manipulations to utilize the dynamic data type for complex applications. In my opinion, By using advanced list operations and algorithms, you can effectively handle complex data structures and implement efficient solutions.

**Plan**: To address this, as lists are versatile, I plan to use advanced operations like Time sort, Insertion sort, Merge sort, linear search and binary search to organize the data efficiently for various computational tasks. Lists are generally preferred due to their flexibility, ease of use, and built-in functionality. With large datasets, lists can grow and shrink at runtime through memory allocation and deallocation. In addition to loading data from a database, running queries against a database can also take a considerable amount of time and resources. Rather than repeatedly calling the database, you can store data in lists in your application's memory to save time and reduce the server load. Work is still in progress on creating the list and testing it with other elements such as append, remove, pop, etc.

Q. Did you meet the course outcomes you planned to meet with this enhancement in Module One? Do you have any updates to your outcome-coverage plans?

This artifact has been improved in a way that aligns with the course outcomes I aimed to achieve.

Course 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."

To demonstrate my ability to create efficient solutions, I will refine the Animal Shelter class's data structure and algorithms based on algorithmic principles. The improvement will also demonstrate my ability to make design trade-offs, such as utilizing advanced algorithm operations with List, which will enhance data access speed and facilitate operations such as Merge sort, Linear search, Time sort, Binary search leading to improved performance.

Course Outcome 4: "Demonstrate an ability to use well-founded and innovative techniques, skills, and tools in computing practices to implement computer solutions that deliver value and accomplish industry-specific goals."

By selecting data structures and algorithms in a creative manner, I enhance the system's value and performance. Its primary objective is to offer a scalable and efficient solution for the industry. A further benefit of this distinction is that it helps manage complexity, enhance scalability, and make maintenance easier. Through algorithm optimization, I will minimize unnecessary processes, increasing the efficiency of the program.

It is possible to enhance the user experience by applying these principles and enhancements to code apps, making them more efficient, performant, and scalable.

The aim of these actions is to showcase our capacity to utilize established and creative methods, expertise, and resources to build in-demand computer solutions that provide value and achieve industry-specific objectives.

Q. Reflect on the process of enhancing and modifying the artifact. What did you learn as you Developing and improving the project was extremely flexible and interactive thanks to MongoDB and Jupyter Notebooks. The process of modeling, querying, and optimizing data was challenging, but valuable lessons were learned, resulting in a significant enhancement of skills and understanding in these areas. It provided me with a valuable opportunity to grow creatively. As a result of the experience, I have made significant strides toward reaching my personal and professional goals.

It was my first time working with MongoDB. While taking my course, I had trouble understanding MongoDB's query language and index design. Working on the project, I faced challenges such as troubleshooting connection issues between Jupyter Notebook and MongoDB, as well as debugging complex queries, requiring a thorough understanding of both tools and a keen eye for detail.

In this study, I gained an understanding of the differences between relational databases (SQL) and NoSQL databases (NoSQL). Using MongoDB's flexible schema, which allows the storage of multiple data types within a single collection, it is ideal for managing unstructured and semi structured data. With the help of a client library such as PyMongo, I became proficient at CRUD (Create, Read, Update, Delete) operations on MongoDB. It showed me how to utilize these tools efficiently for data-driven projects and deepened my understanding of the data analysis process.

Additionally, I can display this project in my resume and portfolio, which will assist me during job applications and interviews. Through the artifact, I have been able to advance my personal and professional goals by increasing my skills, knowledge, and experience.

**References**

*Best way to teach data structures and algorithms? | Researchgate. (n.d.-b). https://www.researchgate.net/post/Best\_way\_to\_teach\_Data\_Structures\_and\_Algorithms*