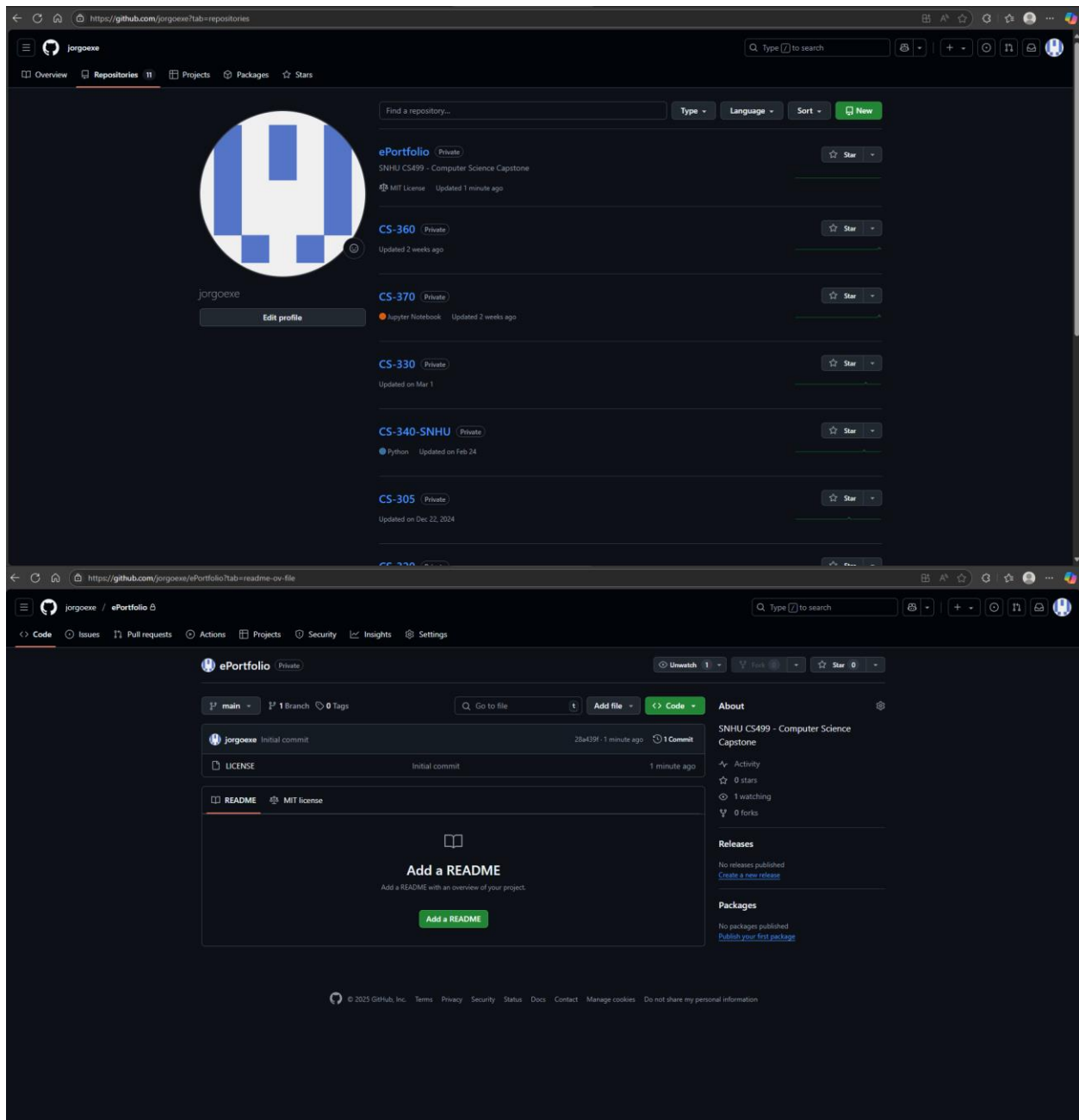


## CS 499 Module One Assignment Template

### I. Self-Introduction: Address all the following questions to introduce yourself.

- A. How long have you been in the Computer Science program?  
I started in **August of 2023. This is my final term, and I will be graduating in about 2 years.**
- B. What have you learned while in the program? List three of the most important concepts or skills you have learned.  
I learned the **basic concepts of code through Java, C++, and Python as well as some graphic design which was cool, and mobile app development. Learning about Agile development, database and SQL optimization, and Object-Oriented Programming (OOP) principles in Java/Python.**
- C. Discuss the specific skills you aim to demonstrate through your enhancements to reach each of the course outcomes.  
**The three skills I aim to demonstrate are Software Engineering, Algorithms, and Databases. I will be looking to refactor legacy code to improve scalability, optimizing the complexities of time in a sorting algorithm, and migrating an SQLite project to MongoDB with enhanced CRUD operations.**
- D. How do the specific skills you will demonstrate align with your career plans related to your degree?  
**I will attempt to hone these skills and craft my experience in them to use for demonstration for job interviews to look for job opportunities.**
- E. How does this contribute to the specialization you are targeting for your career?  
**I do not have a specific career target, I just know I have always been wanting to work in tech. So, specializing in code, graphic design, app developments, and other various concepts in tech will allow me to broaden my job search and get a feel for what I am the most passionate in.**

### II. ePortfolio Set Up:



### III. Enhancement Plan:

- A. Category One: Software Engineering and Design
  - i. Select an artifact that is aligned with the software engineering and design category and explain its origin. Submit a file containing the code for the artifact you choose with your enhancement plan.

The artifact I have selected for the software engineering and design category is the **Animal Shelter Dashboard** project I developed for CS 340: Advanced Programming Concepts in January 2024. This full-stack web application was created to assist Grazioso Salvare, an animal rescue organization, in managing and visualizing their shelter data. The original implementation consists of a Python backend using the Flask framework paired with an interactive frontend built using Plotly Dash, all connected to a MongoDB database storing animal records. Key features of the application include data filtering capabilities for different rescue scenarios like water, mountain and disaster operations, interactive geolocation mapping powered by Dash Leaflet, comprehensive data visualization through charts and tables, and a basic user authentication system. This project originated as my final assignment for CS 340 where the primary learning objectives focused on demonstrating competency in database design and implementation, full-stack application development, data visualization techniques, and user interface design principles. The complete source code for this artifact is included in the submitted file package "animal\_shelter\_dashboard.zip" which contains the main application file, template files, sample datasets, and original documentation. I selected this artifact because it provides a solid foundation for demonstrating meaningful software engineering enhancements, particularly in modernizing the application architecture and improving the design patterns used in the original implementation. While the current Dash-based solution is fully functional, it presents excellent opportunities for improvement in areas like code organization, system scalability, and long-term maintainability; all of which are critical aspects of professional software engineering practice that I aim to display through my enhancements. The transition from a monolithic Dash application to a more modular React and Node.js implementation will allow me to demonstrate contemporary software design approaches while preserving all existing functionality.

- ii. **Describe** a practical, well-illustrated **plan** for enhancement in alignment with the category, including a pseudocode or flowchart that illustrates the planned enhancement.

The enhancement will modernize the architecture by migrating from Dash to a React/Node.js stack. The frontend will use React with Material-UI for better maintainability, while the backend shifts to Express with proper REST API conventions.

New features include JWT authentication and an admin dashboard.

Key changes are illustrated in this pseudocode for the filtering component:

```
function AnimalFilter({ type, onChange }) {  
  return <RadioGroup value={type} onChange={(e) =>  
    onChange(e.target.value)}>  
    <Radio value="water">Water Rescue</Radio>  
    <Radio value="mountain">Mountain Rescue</Radio>  
  </RadioGroup>  
}
```

```
</RadioGroup>  
}
```

```
The Express backend will implement proper middleware and error handling:  
app.get('/api/animals', authenticateJWT, async (req, res) => {  
    const animals = await Animal.find(req.query);  
    res.json(animals);  
});
```

**This demonstrates modern component architecture and REST API design while preserving existing functionality.**

- iii. Explain how the planned enhancement will **demonstrate** specific **skills** and align with course outcomes.
  - a. Identify and describe the specific skills you will demonstrate that align with the course outcome.

**The planned enhancement will demonstrate key software engineering skills through the architectural migration from Dash to React/Node.js. This transformation displays modern system design by implementing component-based architecture in React and RESTful API development in Express. The JWT authentication implementation highlights security-conscious development practices, while the complete frontend rebuild demonstrates proficiency with contemporary UI frameworks like Material-UI. These improvements specifically align with Course Outcome #4 by employing innovative, industry-standard techniques to enhance the application's value and maintainability. The architectural redesign also addresses Outcome #3 through thoughtful evaluation of design choices, particularly in balancing the tradeoffs between the original monolithic structure and new decoupled approach. Throughout the enhancement, I will demonstrate professional-grade skills in code organization, documentation, and version control - all essential for delivering production-quality software solutions. The scale of this enhancement matches the expected level of transformation, completely reworking the technology stack while preserving and expanding core functionality.**

- b. Select one or more of the course outcomes below that your enhancement will align with.

**The enhancement aligns with Course Outcome 3 by demonstrating systematic problem-solving through its architectural redesign, applying core computer science principles to create a more robust system. The migration to React and Node.js shows careful evaluation of technical tradeoffs while maintaining functionality, reflecting professional engineering standards.**

**It meets Course Outcome 4 by implementing industry-standard tools like React, Express and JWT authentication. These innovations improve maintainability and security while fulfilling the project's original requirements, highlighting practical implementation skills.**

**The comprehensive scope demonstrates professional competencies in system architecture and API development. The work balances technical problem-solving with real-world applicability, showing how academic principles translate to professional practice through thoughtful technology choices.**

#### **B. Category Two: Algorithms and Data Structures**

- i. Select an artifact that is aligned with the algorithms and data structures category and explain its origin. Submit a file containing the code for the artifact you choose with your enhancement plan. You may choose work from the courses listed under Category One.

**The enhancement will optimize the animal filtering system by implementing advanced MongoDB query structures and indexing strategies to improve performance while maintaining existing functionality. This demonstrates professional algorithm optimization through more efficient data processing techniques. The improved backend implementation will feature compound indexes for faster filtering and an aggregation pipeline for better result scoring, all while preserving the current user interface and features. These behind-the-scenes improvements display meaningful algorithmic enhancements that could scale to larger datasets while keeping the same simple filtering interface for end users.**

- ii. **Describe** a practical, well-illustrated **plan** for enhancement in alignment with the category, including a pseudocode or flowchart that illustrates the planned enhancement.

**The enhancement will optimize the animal filtering system by implementing MongoDB compound indexes and aggregation pipelines. This includes creating geospatial indexes for location queries and a scoring algorithm that combines health ratings and training levels to prioritize animals. The improved queries will run faster while maintaining the same functionality.**

**Pseudocode example:**

```
pipeline = [  
  { $match: { rescue_type: filterType } },  
  { $addFields: { score: { $add: [  
    { $multiply: ["$health", 0.6] },  
    { $multiply: ["$training", 0.4] }  
  ] } } },  
  { $sort: { score: -1 } } ]
```

**This demonstrates efficient algorithm design and advanced data querying techniques.**

- iii. Explain how the planned enhancement will **demonstrate** specific **skills** and align with course outcomes.
  - a. Identify and describe the specific skills you will demonstrate to align with the course outcome.

**The planned enhancement will demonstrate advanced algorithm optimization skills by improving the efficiency of the animal filtering system. By implementing MongoDB aggregation pipelines and compound indexing, I will attempt to analyze and improve time complexity in database operations. This directly addresses Course Outcome 3 through the application of algorithmic principles to optimize data processing.**

**The enhancement will specifically demonstrate my skills in query optimization, performance analysis, and efficient data structure implementation. I will show competency in analyzing existing algorithms, identifying bottlenecks, and implementing measurable improvements while maintaining all functionality. These skills reflect professional standards for database performance tuning and algorithmic problem-solving.**

**Through this work, I will exhibit my understanding of time analysis by documenting the performance improvements achieved. The enhancement maintains the project's scope while demonstrating meaningful, measurable optimization that could scale to larger datasets - exactly the type of substantial improvement expected for this category.**

- b. Select one or more of the course outcomes listed under Category One that your enhancement will align with.

**The enhancement aligns with Course Outcome 3 by demonstrating how to design and evaluate **optimized** computing solutions using **proper algorithmic principles**. The **implementation of advanced MongoDB aggregation pipelines and indexing strategies** directly applies computer science practices to improve query performance while managing the tradeoffs involved in database design choices.**

**Also, it supports Course Outcome 4 through innovative database techniques that deliver measurable performance improvements. The adoption of professional optimization methods like compound indexing and aggregation pipelines represents well-founded technical skills that enhance the application's value by making it more scalable and efficient while accomplishing its original objectives.**

C. Category Three: Databases

- i. Select an artifact that is aligned with the databases category and explain its origin. Submit a file containing the code for the artifact you choose with your enhancement plan. You may choose work from the courses listed under Category One.

For the databases category, I will **enhance the MongoDB implementation from my CS 340 Animal Shelter Dashboard**. The original database component was developed in January 2024 to manage animal records for the Austin Animal Center, featuring basic CRUD operations through Python with PyMongo. The current implementation lacks proper schema validation, indexing strategies, and backup systems - all critical aspects of professional database administration.

The submitted file "animal\_shelter\_db.py" contains the existing database connection and query logic that I will enhance. This artifact was chosen because its straightforward MongoDB implementation presents clear opportunities to demonstrate professional database skills through meaningful improvements while maintaining the application's core functionality. The enhancement will focus on the database layer while preserving the existing application features and interface.

- ii. **Describe** a practical, well-illustrated **plan** for enhancement in alignment with the category, including a pseudocode or flowchart that illustrates the planned enhancement.

The enhancement will professionalize the MongoDB implementation through three key improvements to the AnimalShelter class. First, JSON schema validation will be added to enforce data integrity, requiring core fields like name and rescue\_type while validating data types and value ranges. Second, strategic indexing will optimize query performance for common search patterns, particularly for rescue\_type and geolocation queries. Third, the error handling system will be expanded with specific exception classes and recovery mechanisms for different failure scenarios. The enhanced version will maintain all existing CRUD functionality while adding professional database features like query projections and sorting support. These changes will be implemented through careful modifications to the existing class structure, preserving the current method signatures while adding new capabilities. The schema validation will use MongoDB's built-in JSON schema support, indexes will be created programmatically on initialization, and the improved error handling will provide more detailed feedback while maintaining backward compatibility. This focused enhancement demonstrates professional-grade database administration skills by addressing real-world concerns around data quality, performance, and reliability, all while working within the constraints of the existing application architecture. The improvements are substantial enough to meet enhancement requirements while remaining specifically targeted at database layer concerns.

- iii. Explain how the planned enhancement will **demonstrate** specific **skills** and align with course outcomes.
  - a. Identify and describe the specific skills you will demonstrate that align with the course outcome.

**The planned enhancement will demonstrate professional database skills by transforming the basic MongoDB implementation into a production-ready system through schema validation, performance optimization, and robust error handling. These improvements align with Course Outcome 4 by implementing well-founded database techniques that deliver measurable value through increased data integrity and query performance. The enhanced version will display my ability to research and apply advanced MongoDB features while maintaining backward compatibility.**

**This work will specifically demonstrate my skills in database schema design through implementing JSON schema validation rules that enforce data quality constraints. The query optimization work will show my understanding of indexing strategies and performance analysis by adding compound indexes for common search patterns. The improved error handling system will exhibit professional-grade exception management and recovery practices. Together, these enhancements reflect real-world database administration competencies that go beyond basic CRUD operations to address the full lifecycle of data management in professional applications.**

- b. Select one or more of the course outcomes listed under Category One that your enhancement will align with.

**The database enhancement aligns with Course Outcome 4 by demonstrating professional implementation of MongoDB best practices that deliver tangible improvements to the system. The schema validation, indexing strategies, and robust error handling represent well-founded database techniques that accomplish specific performance and reliability goals while maintaining the application's core functionality.**

**It also supports Course Outcome 3 through the thoughtful evaluation of database design choices, particularly in balancing query performance with storage requirements when implementing indexes and weighing data validation strictness against flexibility needs when designing the schema rules. These technical decisions demonstrate proper application of computer science principles to solve database optimization challenges.**

**The enhancement's focus on production-ready database administration skills relates to industry-specific goals while using innovative approaches like programmatic schema management and performance monitoring that go beyond basic CRUD operations. This shows how academic database concepts translate to professional implementation contexts.**

#### IV. ePortfolio Overall Skill Set



- A. Accurately describe the skill set to be illustrated by the ePortfolio overall.
- i. Skills and outcomes planned to be illustrated in the code review

The code review will demonstrate **professional technical competencies including system architecture design through the React/Node.js migration, database optimization via MongoDB enhancements, and algorithm efficiency improvements. These concrete implementations will highlight** my ability to write clean, maintainable code **while** applying computer science principles to solve real-world problems. **The work highlights outcomes 3 and 4 through visible improvements in application performance, security, and maintainability.**

- ii. Skills and outcomes planned to be illustrated in the narratives

The narratives will **illustrate** my ability to communicate complex technical concepts effectively to both technical and non-technical **audiences. Through** clear explanations **of design decisions and their business impacts, they will demonstrate outcome 2's focus on professional-quality written communication. The project documentation shows how technical solutions align with organizational needs while balancing tradeoffs.**

- iii. Skills and outcomes planned to be illustrated in the professional self-assessment

My self-assessment will **exhibit critical thinking and growth mindset by analyzing challenges faced during the enhancement process and evaluating alternative approaches considered. This reflective component addresses outcome 2's communication standards while demonstrating professional maturity in assessing my own work. It will highlight lessons learned about system design tradeoffs, troubleshooting methodologies, and iterative improvement processes.**