CS 499 Module One Assignment Template

Complete this template by replacing the bracketed text with the relevant information.

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

A. How long have you been in the Computer Science program?

I have been in the Computer Science program here at SNHU for almost 18 months, transferring in some previous courses and learnings with my first exposure to college being in 2011.

B. What have you learned while in the program? List three of the most important concepts or skills you have learned.

During my time in this program, I have learned quite a bit as I felt like I was starting from close to zero as far as my computer science knowledge. The concepts that have been most important are learning a programming language, understanding how projects run, and where to find the best resources to go to because the field is so quickly evolving, you can't possibly know everything but it's always good to know where to look. Learning a programming language was critical to thinking like a computer scientist and being super analytical with processes.

C. Discuss the specific skills you aim to demonstrate through your enhancements to reach each of the course outcomes.

This course will include making enhancements in three areas to a previous project. In performing these enhancements, I will demonstrate skills that align with the course outcomes. Writing the application in Kotlin will showcase the ability to adapt to new technologies and use innovative tools, crucial for software engineering and design. Adding a new search function to the Android application will demonstrate skills in expanding existing software, integrating new functionality, and considering user needs, all of which contribute to designing and delivering professional-quality solutions. The migration from SQLite to Firestore for database management will highlight the ability to evaluate trade-offs in development decisions, adapt to industry-standard tools, and potentially improve data security, aligning with the outcomes of using well-founded techniques and developing a security mindset. While not directly evident from the technical enhancements, the implementation of these changes in a professional environment would likely involve collaboration with team members and effective communication of changes and the reasons for those changes. This addresses the outcomes related to building collaborative environments and delivering professional-quality communications. Together, these enhancements reflect a range of skills essential in modern software development, demonstrating the ability to solve complex problems, adapt to new technologies, consider security implications, and effectively communicate in a professional context.

D. How do the specific skills you will demonstrate align with your career plans related to your degree?

I am actively pursuing my goal of becoming a Cyber Officer in the Air Force, the skills I'm developing align perfectly with my career plans. My proficiency in programming languages, database management, and application development will be crucial for understanding and advancing the Air Force's cyber capabilities. The ability to adapt to new technologies, as demonstrated by learning Kotlin and implementing new features, mirrors the constant evolution in the range of cyber operations that exist within the DOD. Additionally, the application of feedback and demonstrating professionalism will be invaluable for leading teams and making plans to improve those teams. By focusing on these technical and leadership skills, I'm preparing myself for the diverse challenges I'll hopefully face in my career path, from defensive operations to potential research and development roles.

E. How does this contribute to the specialization you are targeting for your career?

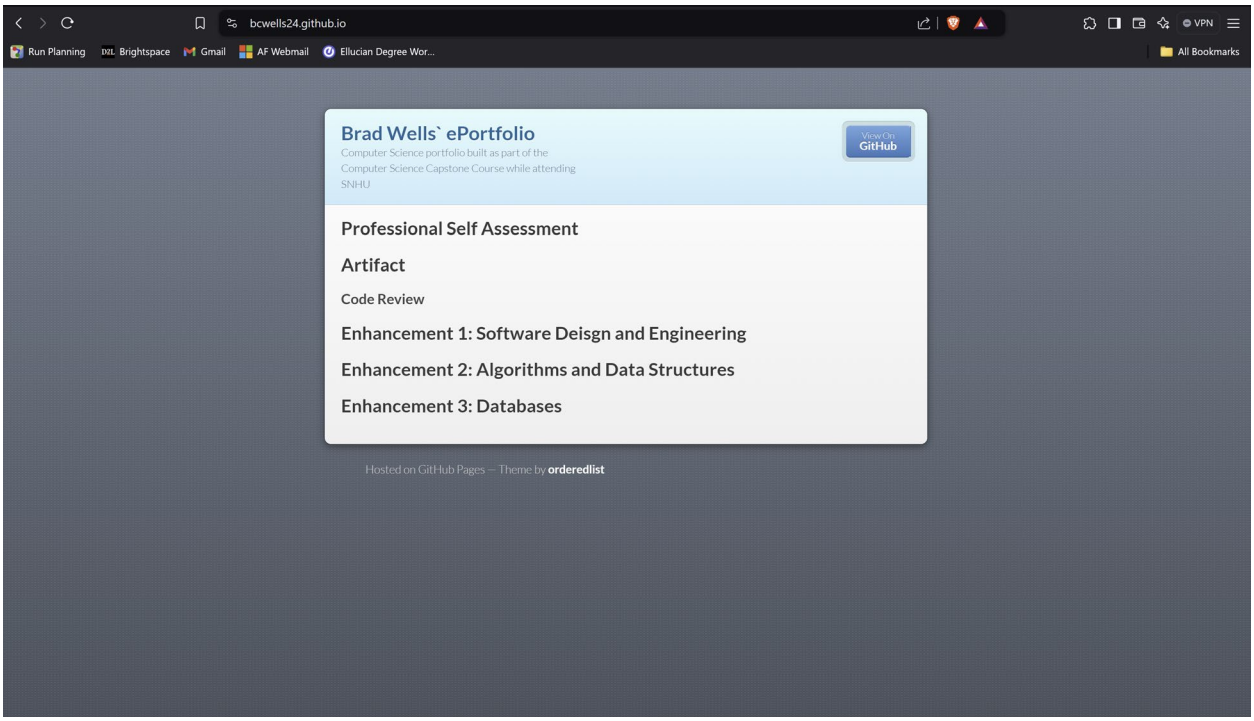
The skills I'm developing through this computer science degree program and the capstone align perfectly with my aspirations. The ability to design and evaluate computing solutions using algorithmic principles will be important in understanding both offensive and defensive cyber operations. Developing a security mindset that anticipates the motives of adversaries is directly applicable to my future role in protecting critical information. The focus on building collaborative environments and professional communication skills will be essential for leading teams and articulating technical concepts to both technical specialists and non-technical leadership. Additionally, the emphasis on using innovative techniques in computing practices aligns with the evolving nature of cybersecurity.

II. ePortfolio Set Up:

A. Submit a **screen capture** of your ePortfolio GitHub Pages home page that clearly shows your URL.
   i. You already have a repository in GitHub where you uploaded projects in previous courses. Your ePortfolio will reside in GitHub but can link to work at other sites, such as Bitbucket.

B. Use the GitHub Pages link in the Resource section for directions on:
   i. How to create your GitHub website and publish code to GitHub Pages
   ii. Issues, such as adding links to other sites

C. Paste a screenshot of your GitHub Pages home page with your URL clearly showing in the space below.



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.

CS 360: Mobile Architecture and Programming focused on designing and building an Android Application throughout the course. Students were given three sets of requirements to pick from in designing their application. I chose to build an application that allows users to enter, track, and manage inventory with data persistence and zero-stock SMS notifications. The artifact, has features like user authentication, inventory management, and SMS notifications, provides a strong base for enhancements. Its legacy Java code creates opportunities for modernization through Kotlin's advanced features and a more modular architecture. These enhancements will significantly improve maintainability, scalability, and alignment with modern software design and engineering standards. This file is: Inventory Management App.zip

Note: Your artifact may be work from the following courses:

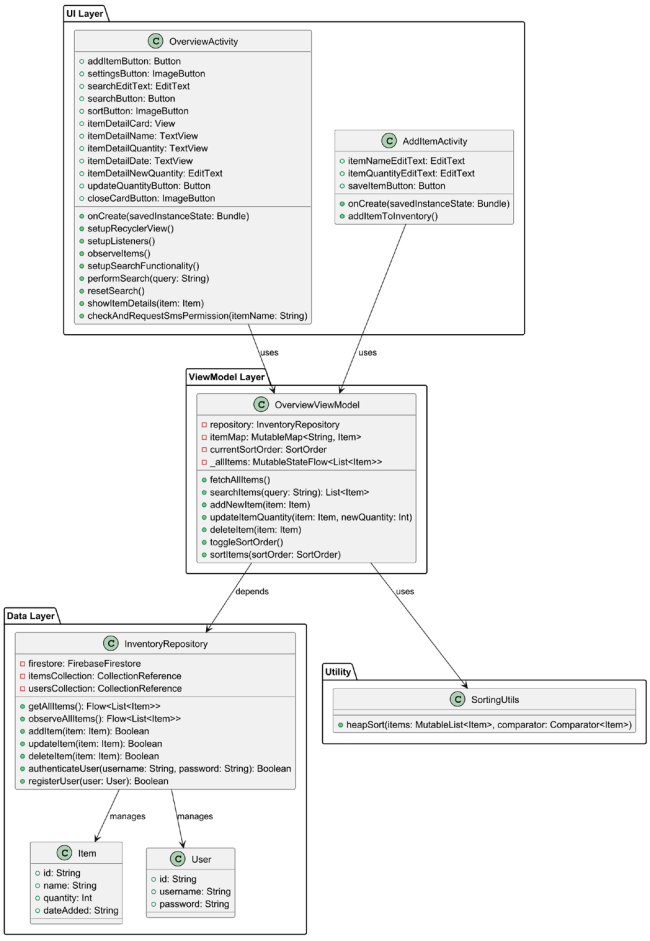
- IT 145: Foundation in Application Development
- CS 250: Software Development Lifecycle
- CS 260: Data Structures and Algorithms
- IT 315: Object Oriented Analysis and Design
- CS 320: Software Testing, Automation, and Quality Assurance
- CS 330: Computational Graphics and Visualization
- CS 340: Advanced Programming Concepts
- CS 350: Emerging Systems Architectures and Technologies

- **CS 360: Mobile Architecture and Programming**
- IT 365: Operating Environments
- IT 380: Cybersecurity and Information Assurance
- CS 405: Secure Coding
- CS 410: Reverse Software engineering
- IT 340: Network and Telecommunication Management
- IT 380: Cybersecurity and Information Assurance

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

For this enhancement, I will be re-coding the existing inventory tracking application from Java to Kotlin while refactoring its design to follow a more modular architecture. This enhancement aligns with improving software design and engineering practices by leveraging Kotlin's modern features, which enhance readability, maintainability, and functionality. Additionally, Kotlin is the Google referred language for Android application development (Android Developers, 2024). This will aid in support and maintainability of the application moving forward.

To carry out this enhancement, I will follow a plan consisting of requirements gathering, design, implementation, testing, and deployment. Currently I am in the design phase of this plan as this documentation is being put together. The requirements gathering included a review of the previous application, noting areas of improvement and key features. Understanding where I wanted to take this project, I began the design phase, which is in progress. Key aspects of this phase include a flowchart for how the application will be refactored and organized. Implementation will include transforming Java classes into Kotlin. The project will be built as a new project to ensure there are minimal to no issues with dependencies when the language and build language configuration are changed; to Kotlin and Kotlin DSL respectively. Testing and validation will commence to ensure proper data flow between modules, user functionality is present, and the User Interface (UI) is pleasing to the user. Finally, deployment will be publishing this app to GitHub and including it as well as documentation in my ePortfolio.



Class Diagram generated utilizing Plant UML (PlantUML.com)

For this category of enhancement, consider improving a piece of software, transferring a project into a different language, reverse engineering a piece of software for a different operating system, or expanding a project's complexity. These are just recommendations. Consider being creative and proposing an alternative enhancement to your instructor.

Think about what additions to include to complete the enhancement criteria in this category. Since one example option is to port to a new language, that is the kind of scale that is expected. This does not mean you need to port to a new language but instead have an equivalent scale of enhancement. Underlying expectations of any enhancement include fixing errors, debugging, and cleaning up comments, but these are not enhancements themselves.

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.

Skills demonstrated in this enhancement include the ability to adapt to new technologies and use innovative tools, crucial for software engineering and design. Also, using algorithmic principles and computer science practices is demonstrated in this enhancement by refactoring the application into a more modular design. Both of these skills demonstrate an understanding of industry best practices by revising something to be more modular, functional, and maintainable by utilizing the preferred language for Android applications.

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

Outcome 3: This enhancement process demonstrates designing and evaluating computing solutions that follow algorithmic principles while managing design trade-offs, such as improving modularity at the cost of additional initial development time.

Outcome 4: The use of Kotlin and modern Android development practices illustrate well-founded techniques, skills, and tools to implement computer solutions that meet industry goals.

Course Outcomes:

1. Employ strategies for building collaborative environments that enable diverse audiences to support organizational decision-making in the field of computer science.
2. Design, develop, and deliver professional-quality oral, written, and visual communications that are coherent, technically sound, and appropriately adapted to specific audiences and contexts.
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.
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.
5. Develop a security mindset that anticipates adversarial exploits in software architecture and designs to expose potential vulnerabilities, mitigate design flaws, and ensure privacy and enhanced security of data and resources.

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.

CS 360: Mobile Architecture and Programming focused on designing and building an Android Application throughout the course. Students were given three sets of requirements to

pick from in designing their application. I chose to build an application that allows users to enter, track, and manage inventory with data persistence and zero-stock SMS notifications. This artifact aligns with this enhancement category because the feature involves handling potentially large datasets where data retrieval is necessary. Adding an item search function introduces complexity by requiring optimized data structures to ensure fast performance. Additionally, adding a sorting function using heap sort will add more functionality and enhance the user experience. Heap sort was selected due to its ability to scale to a large dataset with a time complexity of ((O)nlogn) in the best, worst, and average cases (Alake, 2024). This enhancement directly improves the app's functionality and aligns with algorithmic principles. This file is: Inventory Management App.zip

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

In the enhancement category of data structures and algorithms, I will be enhancing this project by implementing a search feature into the application using HashMap. In addition to the search functionality, I will be adding a sort function to the main inventory table to quickly sort the data for the user by calling a Heap Sort algorithm. This will allow for efficient item searches on the main inventory screen. In order to implement this enhancement, I will follow a similar plan to enhancement one including requirements, design, implementation, testing, and deployment.

This enhancement is currently in the design process. Prior to design, a thorough review of the artifact and understanding of the new scope of requirements was essential. These requirements include being able to search for an item by name and include items that are partial matches to the search query. The input data will be the search query, and the output will be the filtered inventory grid on the main screen of the application. The design of this enhancement can be broken down at the high-level here:

i. Data is loaded into HashMap:
    a. Create a HashMap with item names as keys and corresponding item details as values.
    b. Populate the HashMap from the database.
ii. Item Search:
    a. Take the user's search query.
    b. Look up the query in the HashMap for exact matches.
    c. For partial matches, check each key to see if it contains the query as a substring.
iii. Update the Display:
    a. Filter the inventory grid based on search results.
    b. Refresh the grid to show only matching items.

Implementing this into the artifact will start when the previous enhancement has been completed. This will allow the functionality to be built upon the newly refactored code, written in Kotlin. In the OverviewActivity, a search bar and logic will be added for handling the search input. The InventoryAdapter will be updated to dynamically display the inventory search results while the InventoryRepository will manage the loading and searching for data. A

HashMapLoader class will be implemented to initialize the HashMap as well as a Seach class to process the search logic. The sort function for the inventory table will be triggered in the OverviewViewModel, calling a Heap Sort method in the app utils, and triggered by user functions that take place in the OverviewActivity. Those actions being pressing to sort button to order the items alphabetically. The UI will also see changes implemented on the .xml files to accommodate the aforementioned functionality. Testing and validation will be performed to ensure proper data flow between modules, the search functionality is working as designed, and the User Interface (UI) is pleasing to the user. Finally, deployment will be publishing this app to GitHub and including it, as well as documentation in my ePortfolio.

For this category of enhancement, consider improving the efficiency of a project or expanding the complexity of the use of data structures and algorithms for your artifact. These are just recommendations. Consider being creative and proposing an alternative enhancement to your instructor. Note: You only need to choose one type of enhancement per category.

Think about what additions to include to complete the enhancement criteria in this category. Since one example option is to port to a new language, that is the kind of scale that is expected. Perhaps you might increase the efficiency and time complexity of an algorithm in an application and detail the logic of the increased time complexity. Remember, you do not need to port to a new language but instead have an equivalent scale of enhancement. Underlying expectations of any enhancement include fixing errors, debugging, and cleaning up comments, but these are not enhancements themselves.

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.

Some specific skills that will be demonstrated with this enhancement are knowledge of algorithmic principles in handling large datasets and applying data structures to a practical use case. Additionally, integrating these back-end functionalities into a UI with real time updates based on the search inputs. The documentation and design demonstrate professional communication and project development.

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

Outcome 3: The enhancement requires designing an efficient search solution using HashMap to optimize lookups as well as selecting Heap Sort. These decisions involve evaluating trade-offs between exact and partial match algorithms for performance and usability.

Outcome 4: The implementation of HashMap, combined with innovative techniques like caching and dynamic UI updates, ensures the solution is both efficient and adaptable to real-world needs.

Outcome 5: Using input validation and falls in line with a security mindset as well as ensuring the HaspMap is encapsulated with a dedicated class and made private.

C. **Category Three: Databases**

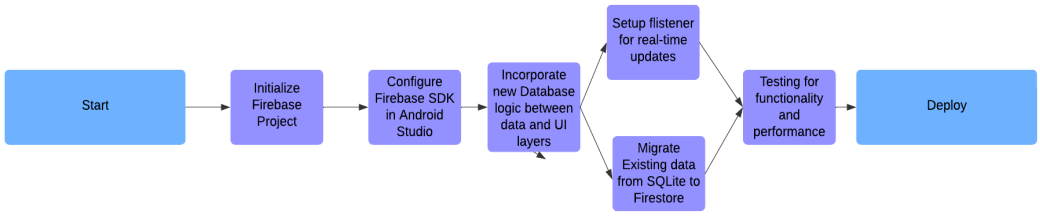
i. **Select an artifact** that is **aligned with the** databases **category** and explain its origin. Submit a file containing the code for the artifact you choose with your enhancement plan. You may choose work from the courses listed under Category One.

CS 360: Mobile Architecture and Programming focused on designing and building an Android Application throughout the course. Students were given three sets of requirements to pick from in designing their application. I chose to build an application that allows users to enter, track, and manage inventory with data persistence and zero-stock SMS notifications. The database used for this application was SQLite, which is easily imported as part of the Android standard library as an import package. The drawback to this approach is that the database is data is stored locally on the device, which makes it inaccessible from other devices or platforms without manual synchronization. This local-only persistence can limit app functionality for multi-device access or cloud-based features unless additional mechanisms like syncing with a remote server are implemented. This file is: Inventory Management App.zip

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

When it comes to enhancing this artifact in the area of Databases, I will abandon the existing SQLite managed database and integrate a cloud hosted NoSQL database using Firestore as part of the Google Firebase development platform. This migration will enable real-time synchronization, multi-device accessibility, and store data in the cloud, which is better suited for a NoSQL database. NoSQL also offers more schema flexibility which will enable users to adapt the database for a wider variety of inventory items, which is more complex in the rigid schemas of SQL (MongoDB). Like the previous two enhancements, I will structure the plan for this in enhancement around requirements, design, implementation, testing, and deployment.

Requirements gathering for this enhancement involved examining the current functionality of the artifact and understanding what features or upgrades I am looking to incorporate into the database enhancement. Those requirements have been identified and currently the design of the enhancement is taking place. The planned design for this enhancement is to create the Firebase Database, adding the necessary dependencies, and configurating the authentication to connect the Android application to Firestore. The existing schema will be mirrored to include items, quantities, date added to the inventory, and Firestore will assign a unique ID to each item. Depicted below is the flow for how this enhancement will be implemented:



Implementation of this enhancement will follow the completion of enhancement 2, following the design plan, beginning with setting up the Firebase project, enabling Firestore, and configuring authentication. Once the Firestore database is ready, dependencies will be added to the project by updating the build.gradle files. Additions, updates, and deletions in SQLite will be mirrored in Firestore, and listeners will ensure the app UI reflects any remote changes. Existing data in SQLite will be migrated to Firestore while maintaining schema alignment although the current data is very limited so the database will be seeded using sample data. The enhancement will undergo testing to validate synchronization, real-time updates, persistence, and performance. Once testing is complete, the enhanced application will be deployed by publishing this app to GitHub and including it, as well as documentation in my ePortfolio.

For this category of enhancement, consider adding more advanced concepts of MySQL, incorporating data mining, creating a MongoDB interface with HTML/JavaScript, or building a full stack with a different programming language for your artifact. These are just recommendations; consider being creative and proposing an alternative enhancement to your instructor. Note: You only need to choose one type of enhancement per category.

Think about what additions to include to complete the enhancement criteria in this category. Since one example option is to port to a new language, that is the kind of scale that is expected. Perhaps you might increase the efficiency and time complexity of an algorithm in an application and detail the logic of the increased time complexity. Remember, you do not need to port to a new language but instead have an equivalent scale of enhancement. Underlying expectations of any enhancement include fixing errors, debugging, and cleaning up comments, but these are not enhancements themselves.

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.

With this enhancement I will demonstrate skills associated with computing solutions, innovative techniques, and professional outcomes to align with course outcomes. By transitioning from SQLite to Firestore, I will showcase my ability to design and implement cloud-based database solutions, leveraging NoSQL concepts to enable real-time synchronization, multi-device accessibility, and schema flexibility. I will employ modern tools and frameworks such as Firebase, Firestore, and Android development techniques to implement a professional and

scalable solution. The enhancement also involves thorough documentation, testing, and deployment, including publishing the project to GitHub and adding it to my ePortfolio.

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

Outcome 1: Employ strategies for building collaborative environments that enable diverse audiences to support organizational decision-making in the field of computer science. The collaborative capabilities introduced by Firebase, such as real-time updates and accessibility from multiple locations, directly support organizational decision-making by ensuring that all users have access to consistent, up-to-date information.

Outcome 2: Designing and delivering professional-quality communications. By documenting the enhancement, providing a detailed technical explanation, and creating visual representations of workflows, I will effectively adapt the information for diverse audiences, showcasing my ability to communicate technical solutions clearly and professionally.

Outcome 3: Designing and evaluating computing solutions using algorithmic principles and managing design trade-offs. Weighing the trade off between SQL and NoSQL, this course outcome aligns with the work I will be performing for this enhancement.

Outcome 4: Using well-founded and innovative techniques, skills, and tools in computing practices. Using more modern approaches in database integration aligns this enhancement of a project built on older methodologies with the course outcomes.

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

This code review will analyze the existing state of the artifact and provide a walkthrough of planned enhancements. Each enhancement is designed to demonstrate specific technical skills while aligning with the course outcomes, advancing the dialogue around software engineering, data structures, and databases. Through this review, I will exhibit my ability to critically assess code, propose thoughtful improvements, and implement solutions that meet modern computer science standards.

The code review will demonstrate all course outcomes by analyzing and enhancing the artifact across software engineering, algorithms, and databases. Outcome 1 is addressed by integrating Firestore to enable real-time synchronization and multi-user collaboration, supporting organizational decision-making. Outcome 2 is demonstrated through clear communication of findings, enhancements, and technical concepts using well-documented code and visual aids. Outcome 3 is reflected in designing efficient solutions, such as a HashMap-based search and sorting algorithms, while managing trade-offs. Outcome 4 is shown by using modern tools like Kotlin and Firebase to implement innovative and scalable solutions. Outcome 5 is

addressed by incorporating secure practices, such as authentication and role-based access control, ensuring privacy and data protection in the database enhancement.

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

The narratives will illustrate skills by providing a reflective overview of the enhancements and the learning process involved in creating the artifact. Each narrative will describe the artifact and explain how it evolved through three key enhancements. These enhancements demonstrate skills in modern software design, data structure optimization, and scalable database integration. The narratives showcase course Outcome 2 by clearly communicating the enhancements and will justify the artifact's inclusion in my ePortfolio. by highlighting how it showcases my abilities to design, implement, and refine software. The narratives will also illustrate Outcome 1 by building collaborative environments through sharing the process that I went through for the enhancements to include challenges faced and lessons learned.

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

In the professional self-assessment, I plan to illustrate skills in collaboration and technical communication to align with the course outcomes. These skills include communicating technical concepts to diverse audiences while solving real-world problems using efficient algorithms and data structures. The assessment will demonstrate my ability to discuss how I have applied modern software engineering principles, such as modular design and refactoring, alongside database management in both relational and non-relational systems. It will also showcase my focus on secure coding practices to mitigate vulnerabilities and protect data. These align with the course outcomes by emphasizing collaboration with Outcome 1, professional-quality communication in Outcome 2, designing efficient solutions and managing trade-offs with Outcome 3, applying innovative techniques and tools with Outcome 4, and developing a security mindset in Outcome 5. Through the assessment, I will reflect on how these skills have been developed and align with the course outcomes demonstrated through my coursework and ePortfolio artifacts.

References

Alake, R. (2024, October 3). *Heap sort explained*. Built In. https://builtin.com/data-science/heap-sort

Android Developers. (2024, June 27). *Android's Kotlin-first approach*. https://developer.android.com/kotlin/first

MongoDB. (n.d.). *Understanding sql vs nosql databases.* https://www.mongodb.com/resources/basics/databases/nosql-explained/nosql-vs-sql