Southern New Hampshire University

CS 499: Module One

I. Self-Introduction

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

I have been in the Computer Science program at Southern New Hampshire University (SNHU) since December 2022. Though it is typically a four-year program, I've been able to progress more quickly due to SNHU's flexibility towards credit transfer. By applying up to 90 credits of prior learning to my program, I accelerated my path to completion. This has therefore allowed me time and space to explore advanced topics and pursue projects of interest. Through these extra-curricular activities, I've developed a passion for teaching and software engineering that prepares me for a career in both fields.

For example, a notable extra-curricular activity that I undertook during my time at SNHU is the National Cyber League, where I joined several students who were either studying Cybersecurity or had an interest in the field in a series of individual and team challenges that tested our problem-solving skills in a fun and engaging game-like environment. In addition to having formed new friendships, I developed a newfound respect and understanding for cybersecurity and might even think about joining the field in the future.

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

SNHU's Computer Science program is unique in a way that it encourages self-learning rather than employing the traditional methods of teaching and learning that is used at brick-and-mortar institutions. Crucial to my development as a software engineer was full stack development, which was covered in **CS465 – Full Stack Development.** Through the class, I learned how to turn a basic HTML, CSS and JavaScript application into a dynamic and responsive web application, complete with a database, using the MEAN (MongoDB, Express, Angular and Node) stack. This knowledge has translated into a number of different projects, most recently the creation of a FAST API.

The second most import concept I learned in SNHU is project management. Most highlighted in **CS250 – Software Development and Lifecycle,** I learned how to use the Agile methodology in structuring my workflow and to work iteratively. This has been beneficial to me in my projects, especially due to my use of Git and GitHub. I am also a Certified Scrum Master, so this has been a way to practice and to keep my skills sharp.

The third most important concept I've learned in my Computer Science program is the use of Python – this was predominantly covered in **IT140 – Introduction to Scripting** and **in CS 340 – Client/Server Development.** Being arguably one of the most versatile programming languages, I've learned to automate certain tasks (such as calculating the costs of certain activities, finding a better alternative to things I want to buy and even budgeting my credit card expenses).

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

   To achieve each course outcome through my enhancements, I aim to demonstrate a range of skills that reflect my growth and adaptability as a software engineer. I will show my problem-solving abilities by identifying and addressing weaknesses in my code, improving their functionality and ensuring that they meet high standards of quality (as well as keeping in line with standard industry practices). I would also like to showcase my quick learning and adaptability by incorporating new frameworks and techniques to demonstrate that I stay up to date with the latest developments in the field. Additionally, I want to show that I can refine my communication skills to clearly convey complex concepts to both technical and non-technical

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

   Since my intended career path lies within the field of academia (I plan to pursue a PhD after my undergraduate degree – which is allowed for in the country I live in), these specific skills will have a great deal of relevance. For one, most of the programs that I will write in my career will be bound by the ethical rules surrounding academia – this means that the programs and the data within them need to be protected as best as possible. I will also be somewhat

responsible for teaching the next generation of software engineers and professionals in the information technology or computer science fields. Since I also write instructions, theses and academic journals, I also have to be a critical thinker, thinking out of the box for every problem that I come across.

The skills that I learn in Computer Science are not specific to the field – they can most definitely be applied to any career that I choose. In this case, I look forward to translating what I've learnt in my CS program to becoming an instructor who can make a lasting impression on the people that I have the privilege to teach.

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

   My career in academia does not include a specialisation. However, if I were to enter the tech industry full-time (as a backup plan), the specialisation that I would choose is software engineering. Time management, project management, communication and sound knowledge of the technologies that I have to use are crucial to my success. Whether I choose to embark on a career in the technology industry or remain in academia, I am confident that I can use my skills to excel and make an impact on other lives.

II. ePortfolio Set Up:

1. Submit a **screen capture** of your ePortfolio GitHub Pages home page that clearly shows your URL.

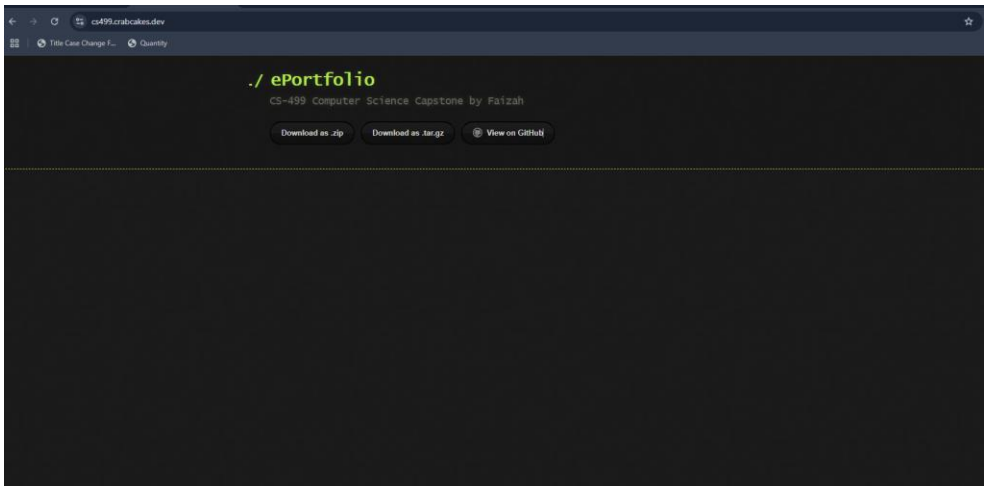


Figure 1: ePortfolio home page.

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

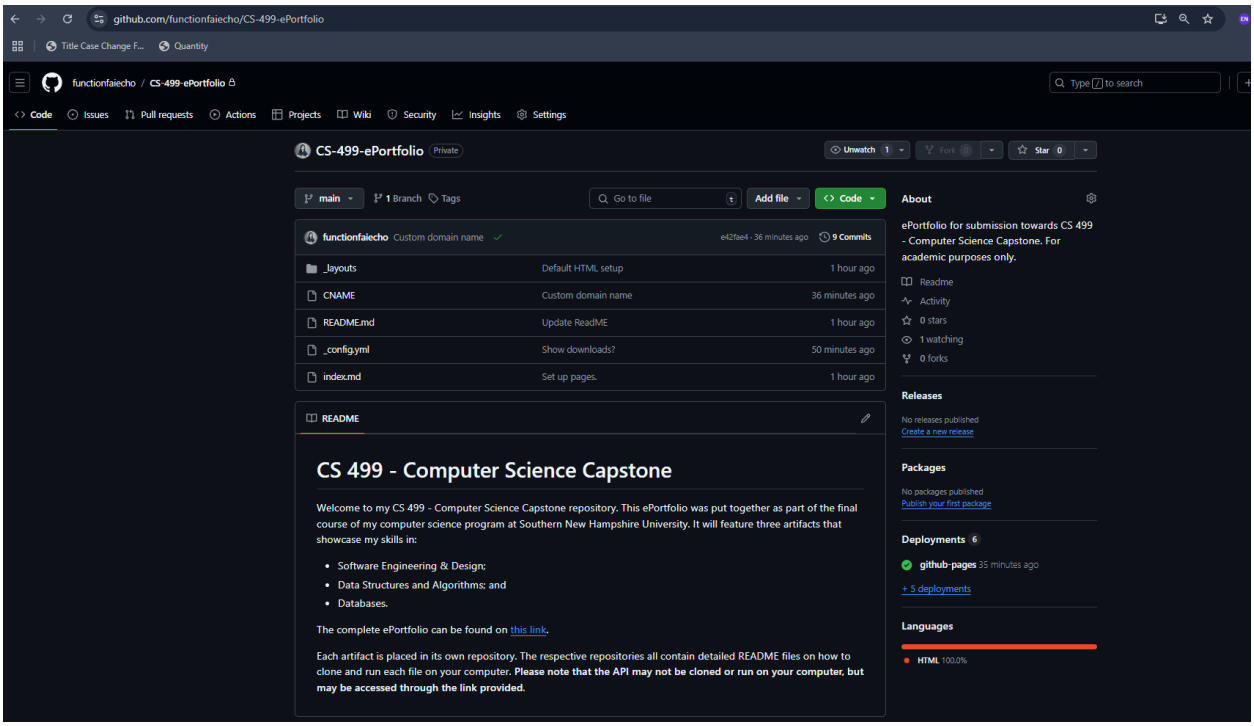


Figure 2: GitHub Pages Homepage with URL

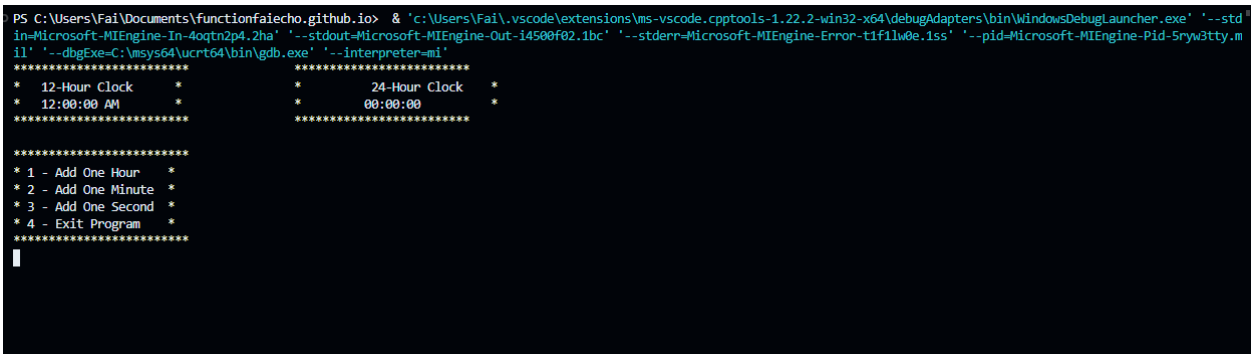
III. Enhancement Plan:

1. **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.

For this enhancement, I chose to use my final project from **CS 210 – Programming Languages.** The source code for this project is attached to my submission. Since I had done my project on Replit originally, I had to re-create my whole project and Dockerise it for ease of access. This application was initially created in C++ and features a 12-hour clock and a 24-hour clock, which the user can manipulate using number inputs (1, 2, 3 or 4).

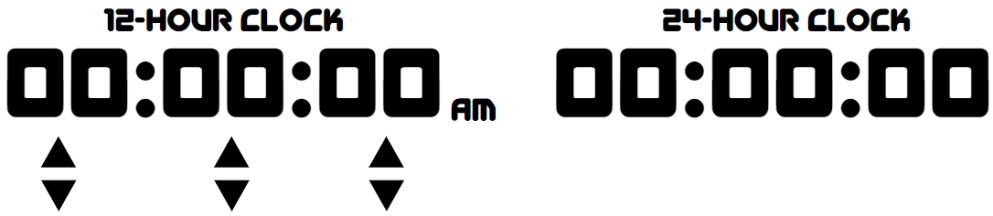
ii. **Describe** a practical, well-illustrated **plan** for enhancement in alignment with the category, including a pseudocode or flowchart that illustrates the planned enhancement.

My planned enhancement is based around that C++ presents as unusual for many people who are not technologically inclined. It is rather complicated and lacks a visually-appealing front-end, although the output has some attempt at it.



The enhancement that I would like to make involves creating a more user-friendly front end for the application using Tailwind, TypeScript and Next JS 14.

To make the web application a little more visually appealing, I will try to incorporate some elements of travel (such as a digital font) and dynamic background changes depending on the time of day it is (light mode and dark mode). Users can then click on either the hour, minute or second part of the times and use the arrow keys (up or down) to add or remove seconds. Since this is only a front-end enhancement, there will be no database or stored information. When the page is refreshed, the time will be reset. A diagram to show the possible enhancement is below:



3: Diagram of possible enhancement

Pseudocode:

```
// Start with state setup for both clocks.
- Use `useState` to keep track of:
  - 12-hour clock time (as a string)
  - 24-hour clock time (also a string)

// Function to display time properly
- Function displayTime():
  - Format time into "hh:mm:ss AM/PM" for the 12-hour clock
  - Format time into "HH:mm:ss" for the 24-hour clock
  - Make sure formatting is accurate.

// Increment functions to handle clock logic
- incrementHour():
  - Add one to the hour state for both clocks
  - Make sure to handle overflow:
    - If 12-hour clock hits 12, must reset to 1 and toggle AM/PM
    - If 24-hour clock hits 24, reset back to 0

- incrementMinute():
  - Add one to the minute state for both clocks
  - If minutes hit 60, reset to 0 and call `incrementHour()`

- incrementSecond():
  - Add one to the second state for both clocks
  - If seconds hit 60, reset to 0 and call `incrementMinute()`

// Clock component to show both clocks side by side
- Create `ClockComponent`:
  - Takes props:
    - `time12` for the 12-hour clock time
    - `time24` for the 24-hour clock time
  - Display two clocks side-by-side using Tailwind CSS styles:
    - Use `flex`, `border`, `text-center` to make it look nice
    - Show the time values and arrow buttons for incrementing

// Set up event listeners for arrow keys
- Use `useEffect` to add event listeners:
  - Detect "ArrowUp" key to increment time
  - Detect "ArrowDown" key to decrement time

// Function to handle key presses
- handleArrowKeyPress(event):
  - Check which part of the time (hour, minute, second) is currently selected
  - Increment or decrement accordingly based on the key pressed

// Main app setup
- Create app component:
  - Combine `ClockComponent` and manage state for the time
  - Include the key event handlers
  - Use Tailwind for layout, maybe `flex`, `justify-center` to centre things properly

// Handle user actions
- When page loads:
  - Set initial state to current time
- When arrow keys are pressed:
  - Update the state for time
  - Re-render to show the updated time, no delay
// Initialise state
- Use `useState` for:
  - 12-hour time
  - 24-hour time

// Display time function
- `displayTime()`: Format 12-hour ("hh:mm:ss AM/PM") and 24-hour ("HH:mm:ss") times

// Increment functions
- `incrementHour()`: Increment hour; handle overflow for 12/24-hour clocks
- `incrementMinute()`: Increment minute; handle overflow, call `incrementHour()`
- `incrementSecond()`: Increment second; handle overflow, call `incrementMinute()`

// Clock component
- `ClockComponent`: Display two clocks side-by-side with Tailwind CSS, include time strings and arrow buttons

// Arrow key events
- Use `useEffect` to handle "ArrowUp" and "ArrowDown" for incrementing/decrementing time

// Handle key presses
- `handleArrowKeyPress(event)`: Determine focused part (hour, minute, second); call appropriate function

// Main app component
- `App`: Combine components, manage state, set up event listeners, use Tailwind CSS for layout

// User interaction
- On mount: Initialise time state
- On key press: Update time, re-render clock
```

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.

This enhancement will predominantly showcase my understanding of the React framework Next JS 14, as well as my ability to use Tailwind CSS and TypeScript, which are common in front-end development. My code comments and the modularisation that this framework allows for gives me the opportunity to explain my enhancement even further within the README after having made it easier for both the non-technical and technical community to use my application. This is in alignment with Course Outcome Two.

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

Course Outcome 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.

2. **Category Two:** Algorithms and Data Structures

Artifact selected: IT140 – Introduction to Scripting. The file is attached in my submission.

I chose an artifact from the first class of my SNHU program as named above. The aim of this class was to understand scripting – and the basics of using Python – through the creation of a simple Choose Your Adventure Game. The original game was a fantasy one – with weapons and the like – but I made a quick change to it to reflect something close to my heart (which is my home country, Singapore). Due to the country's stance towards anything that remotely mentions a weapon, I decided instead to make it an educational journey where people can travel virtually through the landmarks on the city state while learning about the rich cultures that make up the harmonious society that we are privileged to live in.

i. 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 plan to introduce a cheat mode feature that will allow players to reach the Marina Bay Floating Platform without worrying about how much they will spend throughout the course of the game. This cheat mode will be activated when (and only if) the player correctly answers a special question at the starting point (Changi Airport). To implement this feature, I will utilise Dijkstra's Algorithm to calculate the most efficient path in terms of cost and number of locations visited (which is set at a minimum of six). This approach will ensure that the players get the best value out of their game.

I chose to use Dijkstra's Algorithm because it provides flexibility to expand the game's

```
Function find_best_path(start, end, min_visits)
    Initialise priority_queue with (0, start, [], 0)  # (cost, current_location, path, visits)
    Initialise best_path as an empty list
    Initialise min_cost as infinity

    While priority_queue is not empty:
        Pop (current_cost, current_location, current_path, visits) from priority_queue

        Add current_location to current_path

        If current_location is not start and current_location is not end:
            Increment visits by 1

        If current_location equals end and visits is greater than or equal to min_visits:
            If current_cost is less than min_cost:
                Set min_cost to current_cost
                Set best_path to current_path
            Continue to next iteration

        For each (next_location, cost) in locations[current_location]:
            If next_location is not in current_path and next_location is not start:
                Push (current_cost + cost, next_location, current_path, visits) to priority_queue

    Return best_path and min_cost
```

4: Pseudocode for Dijkstra's Algorithm

complexity by adding more constraints, different routes or maybe even new game modes in the future. I could, for example, introduce objectives in the game to visit some places and avoid others.

Dijkstra's algorithm starts at the initial location (Changi Airport) and keeps track of the current cost, current location, the path taken, and also counts the number of places visited so far. It uses a priority queue (or min-heap) to always expand the path that has the lowest cost so far.

ii. 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.

Since Python ordinarily lacks a visually appealing front-end, my focus is on showcasing my ability to build collaborative environments (through well-commented code) and crafting well-written communications (through the README that comes with it). The skills that I will demonstrate to align with the course outcomes that I've selected in part (b) include my understanding of Python and writing clean and efficient code.

To address Course Outcome 1, I will demonstrate my skills in writing code that is not only functional but also easy for others to understand and build upon should they desire. This means using clear and consistent formatting, meaningful variable names and modular functions to keep the code readable and maintainable. I will also make sure that the code is well-commented so that people do not get lost within the lines and can quickly grasp what each part is doing. The README file will act as a guide for anyone who wants to play the game or contribute to the project by explaining everything from the installation to gameplay details. This also makes the project accessible to the wider audience and supports decision-making by providing all the required information in a clear and concise manner.

To address Course Outcome 3, I will show my ability to design and evaluate a computing solution using algorithmic principles. By implementing Dijkstra's algorithm into my game, I address the challenge of finding the best path to the destination while considering constraints like cost and number of locations that the player would need to visit. In doing this, I demonstrate my understanding of algorithms to solve practical problems, and also

manage trade-offs like balancing between the shortest path and minimum number of required visits.

Knowledge for this particular enhancement comes from both IT140 – Introduction to Scripting and MAT230 – Discrete Mathematics (the latter was taken at another institution, which I received credit for at SNHU).

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

- **Course Outcome 1:** Employ strategies for building collaborative environments that enable diverse audiences to support organizational decision-making in the field of computer science.
- **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.

3. **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 this enhancement, I would like to work on the same artifact as in Enhancement One – my CS 210 – Programming Languages application. Since I would already have built a front-end for the first enhancement, I will continue by adding a few more features that would require a database. This application was built as part of my module to demonstrate our understanding of C++, and features a clock that can be manipulated through user input.

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

My plan for enhancement is to incorporate user accounts and time zone management. I will integrate user authentication, preference storage and dynamic time display based on user preference. The app will allow users to register and log in, storing their credentials securely. Upon registration, users will provide their email, password and a default time zone. This data will be stored within a database (in this case, MongoDB), using Next.js API routes. When the user logs in, their credentials will be verified, and a JSON Web Token (JWT) will be generated to manage their session securely.

I will also add the necessary security checks with API middleware to ensure that only authenticated users can access sensitive routes, providing a secure environment for the information that my app stores.

Pseudocode (on the next page)

```
// User Registration
        registerUser(email, password, timeZone)
            // Check all fields are provided
            if (email, password, or timeZone not provided)
                return error("All fields are required.")

            // Hash password for security
            hashedPassword = hash(password)

            // Check if user already exists
            if (userExists(email))
                return error("User already exists.")

            // Create new user with hashed password and time zone
            user = createUser(email, hashedPassword, timeZone)

            // Save new user to the database
            saveUserToDatabase(user)
            return success("User registered successfully.")

        // User Login
        loginUser(email, password)
            // Check all fields are provided
            if (email or password not provided)
                return error("All fields are required.")

            // Get user from the database
            user = findUserByEmail(email)

            // Validate credentials by comparing password
            if (user not found or passwords don't match)
                return error("Invalid credentials.")
```

```
    // Generate JWT token
    token = createJWT(user.id)
    return success({ token, "Login successful." })

// Middleware to Verify Token
verifyToken(request)
    // Get token from headers or cookies
    token = getTokenFromRequest(request)

    if (token not provided)
        return error("Unauthorized access: No token provided")

    try
        // Verify token
        decoded = verifyJWT(token, secretKey)
        request.user = decoded  // Attach user info to request
        return proceed(request) // Move to next step
    catch (err)
        return error("Forbidden: Invalid token")

// Fetch User Preferences (Protected Route)
fetchUserPreferences(request)
    // Verify user authentication
    if (verifyToken(request) fails)
        return error("Unauthorized access.")

    // Get user from the database
    userId = request.user.id
    user = findUserById(userId)
    if (user not found)
        return error("User not found.")

    // Return user's time zone
```

```
    return user.timeZone

// Update User Preferences (Protected Route)
updateUserPreferences(request, newTimeZone)
    // Verify user authentication
    if (verifyToken(request) fails)
        return error("Unauthorized access.")

    // Get user from the database
    userId = request.user.id
    user = findUserById(userId)
    if (user not found)
        return error("User not found.")

    // Update user's time zone
    user.timeZone = newTimeZone
    saveUserToDatabase(user)
    return success("Time zone updated successfully.")

// Calculate Time based on time z  one
calculateTime(time, timeZone)
    // Convert current time to user's time zone
    adjustedTime = convertTimeToTimeZone(time, timeZone)
    return adjustedTime
```

5: Pseudocode for adding user auth and timezone preferences

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.

I will showcase my ability to write efficient and secure code, especially focusing on user authentication, data handling and interacting with databases. I will also apply critical thinking to develop solutions for common problems. In doing this I will also implement security measures such as hashing passwords, verifying tokens and managing sensitive data to prevent vulnerabilities like SQL injection or data breaches. I will also demonstrate clear and concise commenting within the code to explain logic and decision-making so that the code can be understandable by other stakeholders. I will also apply middleware, which is for token verification and protected routes to enhance security and modularity in application design.

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

Course Outcome 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.

Course Outcome 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.

Course Outcome 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.

IV. ePortfolio Overall Skill Set

1. 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 skillset that will be demonstrated in my code review are my attention to detail and my ability to recognise and communicate my shortcomings and how I am looking to rectify them. I will do this by thoroughly scripting my code review and making sure that I do not miss out on any points that I may have put together to speak on. In addition, I will also showcase my ability to teach – albeit not to a live audience – through tailoring my script to be well-understood even by those

who do not have a background in technology (consistent with Course Outcome 2). I will also speak and elaborate on how my enhancements will improve my code either by its performance,

The planned outcomes specific to my code review are:

Course Outcome 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.
Course Outcome 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.

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

From my initial assessment, the narratives (in the form of journals and milestones) are a mixture of showcasing research skills and justifying the work that I do for each enhancement. Therefore, consistent with Course Outcome 2, I will demonstrate my ability to design, develop, and deliver professional-quality oral, written, and visual communications that are coherent, technically sound, and appropriately adapted to specific audiences and contexts. The research journals will be written more academically (as I will view them as mini academic papers that will include APA 7 citations), whereas the narratives will be a more in-depth explanation of my thought process and rationale in making my planned enhancements to my code.

Course outcomes to be demonstrated:

Course Outcome 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.

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

The professional self-assessment is an opportunity for me to reflect on my knowledge and on the professional that I present myself to be when I enter the field of technology (or even academia) upon graduation. As someone who enjoys full-stack development, I plan to elaborate on my skillset and show that I am constantly learning, trying out new frameworks and always looking for better and more efficient ways to create applications that serve the wider community in any way that I can. I will also reflect upon how SNHU has prepared me to be an all-round individual in my field, and also prepared me to contribute to the lives of future computer science students – whose shoes I was once in. The outcomes that I want to showcase in my professional self-assessment include:

Course Outcome 1: Employ strategies for building collaborative environments that enable diverse audiences to support organizational decision-making in the field of computer science.

Course Outcome 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.