# CS 499 Module One Assignment

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Computer Science Capstone

1. **Self-Introduction:** Address all of the following questions to introduce yourself.
   1. How long have you been in the Computer Science program?

**I have been in the SNHU Computer Science program for a year and 3 months, where I started in April 2023 during the 23EW5 term. At the time, I transferred in 30 credits from University of California, Irvine and City College of San Francisco.**

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

**While in SNHU’s Computer Science program, I’ve learned an invaluable amount of information from a wide range of areas of study involving the tech career field. Aside from learning about the software development lifecycle (SDLC) and the tradeoffs between popular operating systems, I’ve studied mobile applications, full stack development, and machine learning. Three of the most important concepts I’ve learned involve adhering to a strong code of ethics, following secure coding best practices, and dedicating oneself to a life of continuous learning. Academically, these experiences have strongly developed my ability to analyze complex problems, deliberate between suitable solutions, and effectively implement their execution.**

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

**To achieve each of the course outcomes, various skills that are effective in the field of computer science will be demonstrated through enhancements made to artifacts in my portfolio. Critical thinking, creativity, and technical proficiency are all important skills that contribute to overcoming challenges and concepts like the course outcomes. Software engineering and design requires attention to detail, communication skills, and research skills to ensure that the correct solutions and trade-offs are considered in a project. At the same time, technical proficiency isn’t enough, and soft skills like being able to communicate effectively and concisely are instrumental when collaborating with a team. Ultimately, each of my enhancements, which are discussed later in this plan, will identify specific skills and proficiencies that also align with the course’s outcomes.**

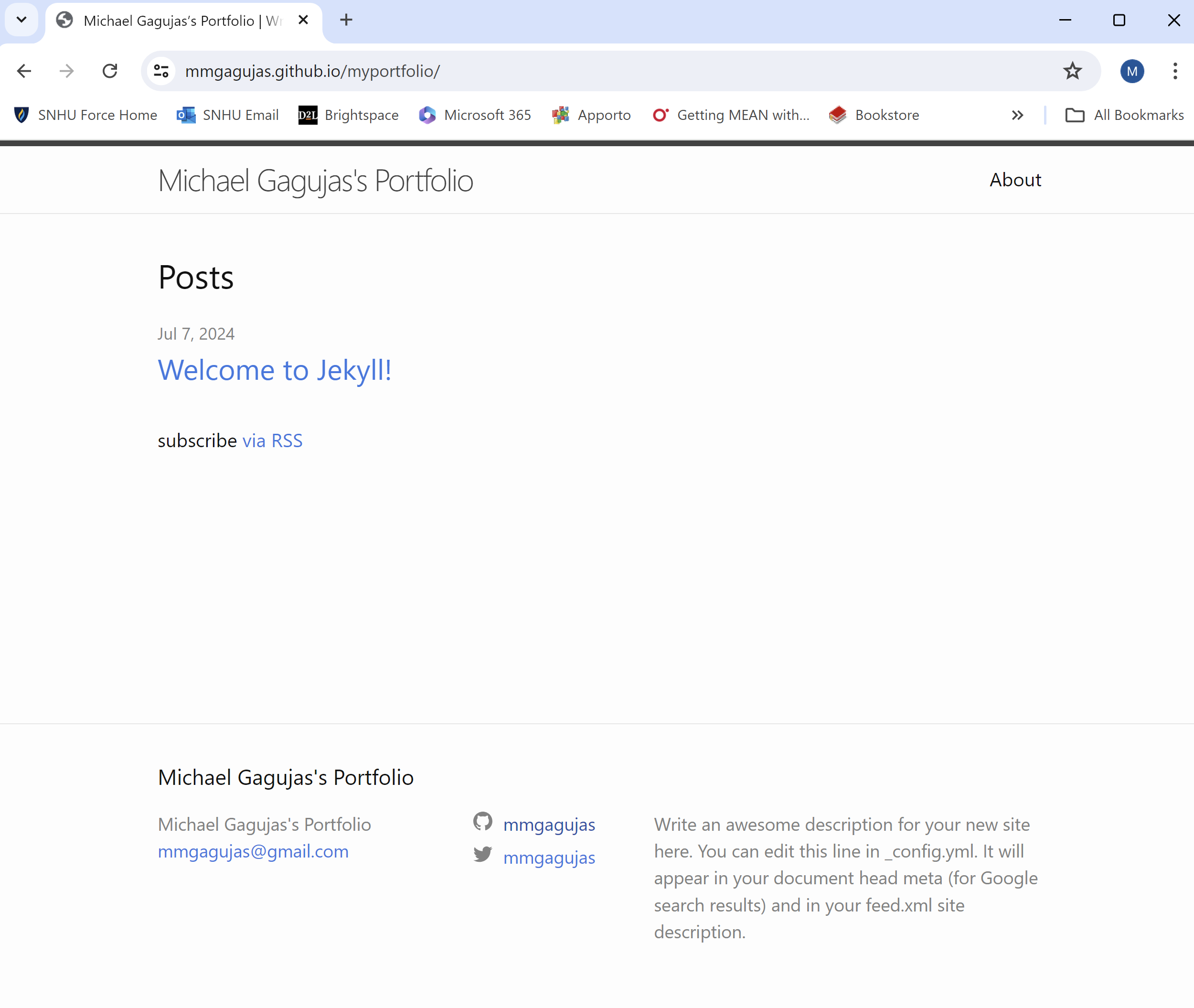
* 1. How do the specific skills you will demonstrate align with your career plans related to your degree?

**For the enhancements that I will implement in this project, I will demonstrate skills like proficiency in programming languages, interface design, and problem-solving skills. As someone who has career plans to become a mobile app developer, these skills are essential for designing, developing, and maintaining mobile applications. Being versatile and proficient in various skills contributes to building a strong foundation, and it is crucial for adapting to the rapidly evolving technology landscape that we live in today.**

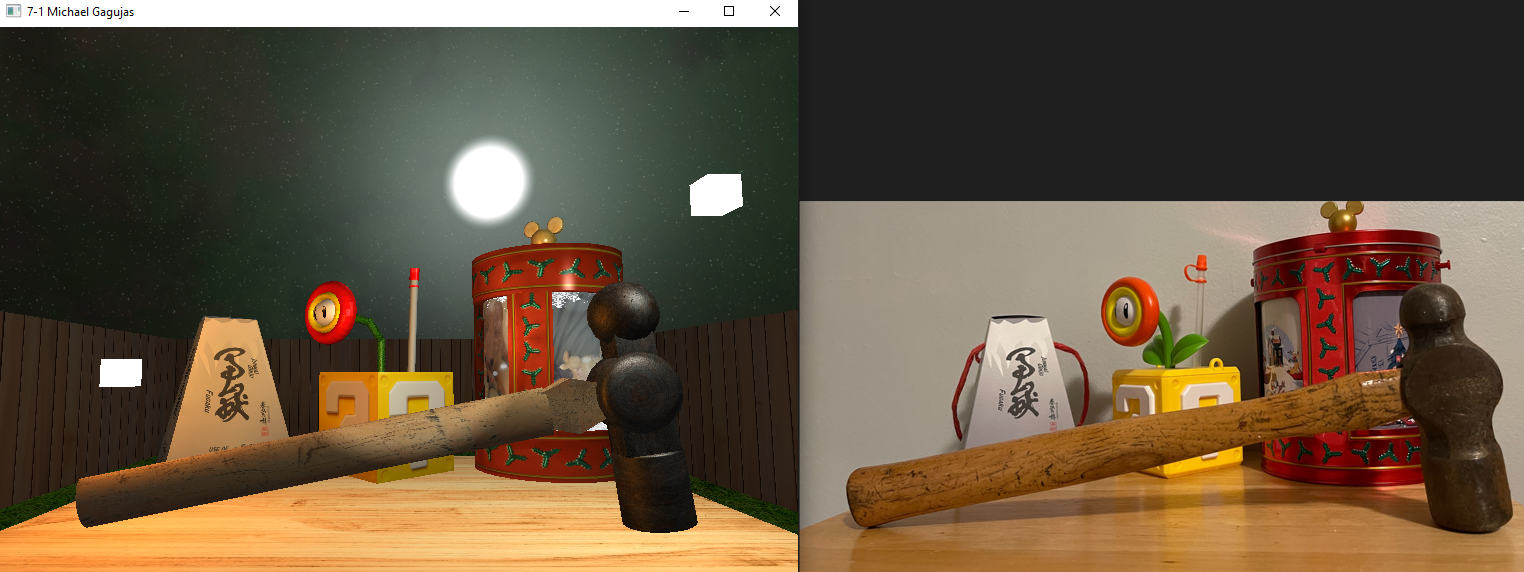
* 1. How does this contribute to the specialization you are targeting for your career?

**This contributes to the specialization that I am targeting for my career because it equips me with the necessary technical skills, adaptability, and problem-solving abilities that are highly valued in the computer science field. It’s not just about writing code, it’s about understanding how to create efficient, scalable, and maintainable software while also working effectively within a team to achieve a common purpose.**

1. **ePortfolio Set Up:**
   1. Submit a **screen capture** of your ePortfolio home page that clearly shows your URL.
      1. 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.
   2. Use the GitHub Pages link in the Resource section for directions on:
      1. How to create your GitHub website and publish code to GitHub Pages
      2. Issues, such as adding links to other sites
   3. Paste a screenshot of your GitHub Homepage with your URL clearly showing in the space below.



1. **Enhancement Plan:** 
   1. **Category One:** Software Engineering and Design
      1. **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.



**Course: CS330 – Computational Graphics and Visualization**

**Artifact: OpenGL 3D Project**

**Attached File Name: 1-3DProject**

**For the Software Engineering and Design category, I chose the final project for “CS330 - Computational Graphics and Visualization” as my artifact. For this project, I had to recreate a 3D version of a 2D image that applied the Phong shading model for lighting, used projected textures, and had nuanced camera controls. It aligns with the category, software engineering and design, because it requires a deep understanding of software design principles, problem-solving skills, and the ability to implement complex algorithms. The project follows a modular design for managing numerous components like meshes, scene objects, and textures, and it contains custom functions that allow a user to navigate and interact with the 3D scene.**

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
  + 1. **Describe** a practical, well-illustrated **plan** for enhancement in alignment with the category, including a pseudocode or flowchart that illustrates the planned enhancement.

**To enhance my OpenGL 3D project in a way that aligns with software engineering and design, I will improve its graphical quality, optimize its performance, and add animated objects to the scene. For improving its graphical quality, the scene will now cast shadows based on the position of light sources, their intensity, and the placement of other objects. To optimize the project’s performance, I will fix the frame rate drops for when the skybox is “toggled on” by either reducing texture size, performing more efficient rendering, or using optimization techniques like back-culling, which prevents unnecessary rendering of objects that are obscured by the camera. Finally, I will add moving objects like fireflies or clouds in the background to improve the realism of the scene. Specifically, I can make multiple instances of a firefly model and use a combination of sine and cosine functions to determine the firefly’s position over time. Also, in general, the system design should utilize principles of good software design like modularity, encapsulation, and abstraction, and it should contain effective documentation that clearly explains the system’s architecture, functionality, and usage.**

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.

* + 1. Explain how the planned enhancement will **demonstrate** specific **skills** and align with course outcomes.
       1. Identify and describe the specific skills you will demonstrate that align with the course outcome.

1. **Understanding Lighting and Shadow Casting: Being able to implement shadows based on the position and intensity of light sources demonstrates an understanding of how light works in 3D environments. This requires in-depth knowledge of shaders and understanding of how the GPU renders certain effects.**
2. **Performance Optimization: Being able to address frame rate drops and apply performance optimization techniques in order to illustrate an understanding of the tradeoffs between graphical quality and performance.**
3. **Animation: Being able to use mathematical functions and tools to create natural and realistic movements that improve a user’s immersion.**
4. **Object-Oriented Programming: Being able to create multiple instances of models and classes that are modular and reusable.**
   * + 1. Select one or more of the course outcomes below that your enhancement will align with.

**1. Employ strategies for building collaborative environments: By making a system more modular, readable, and maintainable, it becomes easier for teams to work on projects collaboratively.**

**2. Design professional-quality communications: By designing a system that is effective towards its purpose, uses descriptive comments, and includes well-structured documentation, I can ensure that technical communications are professional and of high quality.**

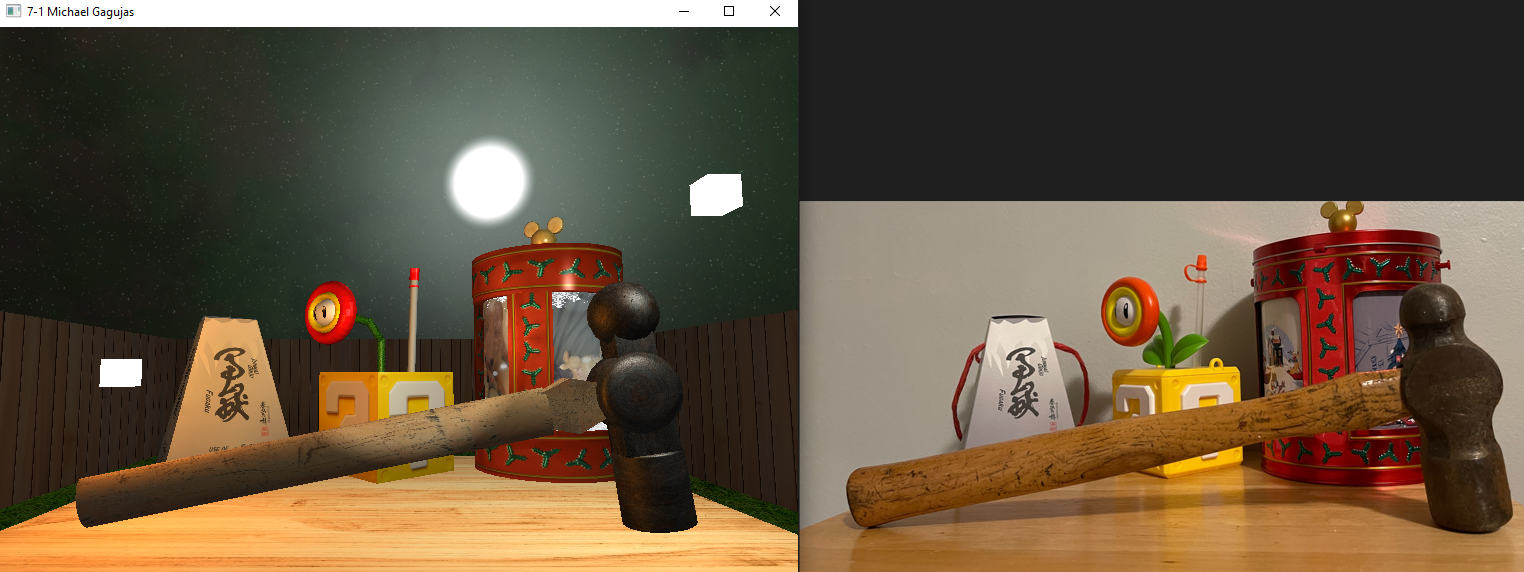
**3. Design and evaluate computing solutions: Improving the graphical quality and optimizing the performance of my OpenGL project involves designing and evaluating computing solutions like reducing texture size, more efficient rendering, and back-culling to solve specific problems like frame rate drops. Choosing between different optimization techniques and considering their trade-offs is a critical aspect of software engineering and design.**

**4. Demonstrate well-founded and innovative techniques: Creating multiple instances of models and using mathematical functions to animate objects is an innovative technique that delivers value by improving realism and enhancing the overall 3D project. In conjunction with the Phong lighting model, textures, and shaders, these techniques contribute to accomplishing industry-specific goals and enhancing the visual appeal of a scene.**

Course Outcomes:

* Employ strategies for building collaborative environments that enable diverse audiences to support organizational decision-making in the field of computer science.
* Design, develop, and deliver professional-quality oral, written, and visual communications that are coherent, technically sound, and appropriately adapted to specific audiences and contexts.
* 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.
* 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.
* 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.
  1. **Category Two:** Algorithms and Data Structures

1. **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.



**Course: CS330 – Computational Graphics and Visualization**

**Artifact: OpenGL 3D Project**

**Attached File Name: 1-3DProject**

**For the Algorithms and Data Structures category, I also chose the OpenGL 3D project from “CS330 - Computational Graphics and Visualization” as my artifact. This project aligns with algorithms and data structures because it requires the application and manipulation of data structures like arrays, matrices, and vectors that store and manipulate 3D coordinates, colors, and textures of an image. In relation to algorithms, this project relies on the efficient use of algorithms to perform operations like transformations, projections, and shading.**

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

**To enhance my OpenGL 3D Scene in regard to data structures and algorithms, I will implement Discrete Level of Detail (DLoD) to optimize the rendering of my 3D scene and improve the overall performance of my application. By creating different versions of my 3D models with varying levels of detail, I can effectively manage the computational resources required for rendering and leverage the power of data structures and algorithms to optimize my OpenGL 3D scene. For objects that are further away from the camera, they will be a low-poly version with less vertices and polygons, and as objects get closer to the camera, they will transition to a high-poly version with more vertices and polygons. The transition will maintain the visual integrity of the 3D scene by using a distance-based algorithm that calculates the distance between the camera and each object in the scene.**

**To manage these different versions of each model, I will utilize a combination of arrays, linked lists, and hash maps. Arrays will be used to store the vertices and polygons of each model. The hash map will be used to initially render the scene while linked lists will store the different versions of each model and make it easier for switching based on camera distance.**

**Pseudocode:**

**// Create different versions of 3D models with varying levels of detail**

**// Function to calculate the distance between the camera and an object**

**// Function to determine the level of detail based on the distance**

**// Function to render an object with the appropriate level of detail**

**// Loop through each object in the scene**

**// Calculate the distance between the camera and the object**

**// Determine the level of detail based on the distance**

**// Render the object with the appropriate level of detail**

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.

1. Explain how the planned enhancement will **demonstrate** specific **skills** and align with course outcomes.
   1. Identify and describe the specific skills you will demonstrate to align with the course outcome.
2. **3D Modeling: Being able to create 3D models with varying levels of detail shows proficiency in 3D model creation and manipulation.**
3. **Graphics Rendering: Being able to apply Discrete Level of Detail (DLoD) to optimize the rendering of a 3D scene shows strong a strong understanding of managing computational resources and maintaining the visual integrity of a 3D scene.**
4. **Understanding of Data Structures: Being able to leverage arrays, linked lists, and hash maps for their benefits demonstrates knowledge of how to use data structures for efficient access and manipulation of data.**
5. **Understanding of Algorithms: Being able to use distance-based algorithms to render the most efficient model of an object demonstrates algorithmic thinking to solve problems.**
   1. Select one or more of the course outcomes listed under Category One that your enhancement will align with.

**3. Design and evaluate computing solutions: By using Discrete Level of Detail and data structures to optimize the rendering of a 3D scene, I am designing a solution that fixes a problem. I am also using algorithmic principles like a distance-based algorithm to manage trade-offs like detail and performance.**

**4. Demonstrate well-founded and innovative techniques: Using well-founded techniques like Discrete Level of Detail and innovative skills like creating different versions of 3D models to better manage computation resources delivers value and improves the overall performance of the OpenGL application.**

* 1. **Category Three: Databases**
     1. **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.



**Course: CS360 – Mobile Architecture & Programming**

**Artifact: Events Mobile App**

**Attached File Name: 3-MobileApp**

**For the Databases category, I chose the final project for “CS360 - Mobile Architecture & Programming” as my artifact. For this project, I had to develop a fully functional mobile application that allowed a user to login, add events to a database, and, after receiving user permission, send SMS messaging notifications. This artifact aligns with the category of databases because it uses SQLite to store event information and user credentials like salted and hashed passwords.**

* + 1. **Describe** a practical, well-illustrated **plan** for enhancement in alignment with the category, including a pseudocode or flowchart that illustrates the planned enhancement.

**To enhance the database in my event’s mobile application, I will connect my mobile application to Firebase so that it can use Firebase Authentication as well as other Firebase services. Firebase Authentication will add an extra layer of security to the application and ensure that only authenticated users can access its database. In addition, my current project only displays inactive buttons for signing in with GitHub and Google. I will further enhance the project by activating these buttons and ensuring that users can sign in with their existing GitHub or Google accounts.**

**For the actual databases inside the mobile application that consist of a user's table and an events table, I will add a more detailed view of each object with practical information that aligns with the specific needs of the application and its users. In addition, I will establish a many-to-many relationship between them as each user can participate in multiple events and each event can have multiple participants. To implement this, a junction table called UserEvents can be made, where the table will use UserID and EventID as foreign keys that reference the primary keys in the Users and Events tables.**

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.

* + 1. Explain how the planned enhancement will **demonstrate** specific **skills** and align with course outcomes.
       1. Identify and describe the specific skills you will demonstrate that align with the course outcome.

1. **Database Design: Being able to design and structure databases with pertinent information demonstrates understanding of data organization, data management, and the principles of database design.**
2. **Understanding of Database Relationships: Being able to establish relationships between different tables demonstrates understanding of complex database relationships.**
3. **Implementation of Authentication: Being able to connect to Firebase and using Firebase Authentication shows skills in implementing secure user authentication.**
4. **Integration of Third-Party Services: Being able to implement signing in with existing GitHub or Google accounts demonstrates the ability to integrate third-party services into an application.**
   * + 1. Select one or more of the course outcomes listed under Category One that your enhancement will align with.

**3. Design and evaluate computing solutions: The solution of connecting to Firebase, activating sign-in through third-party services, and improving database relationships evaluates the trade-offs involved in making design decisions.**

**4. Demonstrate well-founded and innovative techniques: The use of Firebase Authentication and implementing a many-to-many relationship between users and events demonstrates the ability to use established techniques and tools in computing practices.**

**5. Develop a security mindset: By using Firebase Authentication, I’m anticipating potential security issues and taking steps to ensure the privacy and security of my app’s data.**

1. **ePortfolio Overall Skill Set**
   1. Accurately describe the **skill set** to be illustrated by the **ePortfolio** **overall**.
      1. Skills and outcomes planned to be illustrated in the code review

**Skills and outcomes planned to be illustrated in a code review are the understanding of code, adherence to coding standards, detection of potential bugs, optimization of code, and improvement of overall code quality. During a code review, ensuring that the code is understandable by others through clear naming conventions and appropriate comments are essential for maintaining a codebase that can be easily navigated and updated by any member of a team. The review should verify that specific coding standards and guidelines are followed, and it provides an excellent opportunity to catch potential bugs and resolve them before they become a problem. Overall, code reviewers should suggest ways to optimize the code, and ultimately, the goal of the code review is to make the code more readable, maintainable, and efficient.**

* + 1. Skills and outcomes planned to be illustrated in the narratives

**The skills and outcomes planned to be illustrated in narratives are technical understanding, problem-solving, communication skills, user empathy, and project management. Being able to show a deep understanding of the software and its architecture is vital for effective storytelling and reviews. Analytical thinking and creativity to solve problems are also crucial because they allow for the identification of issues and must be communicated clearly. User empathy is another key skill that contributes to understanding who your audience is and how you can communicate effectively with them. Overall, narratives should demonstrate a comprehensive understanding of user needs and is essential in project management for ensuring that decisions align with needs.**

* + 1. Skills and outcomes planned to be illustrated in the professional self-assessment

**The skills and outcomes planned to be illustrated in a professional self-assessment would be technical skills, soft skills, and career development outcomes. Skills specific to mobile application developers should be emphasized to show proficiency and capability in the field. Demonstrating an understanding of UI/UX principles, knowledge of back-end computing services, and familiarity with APIs and data integration should be strong areas for a mobile application developer. In addition, soft skills like effective communication, teamwork, and adaptability should be demonstratable to show how one can effectively work within a team, manage challenges, and adapt to changing circumstances. Another aspect to consider in a professional self-assessment is how career development outcomes have been achieved and what they signify in terms of professional growth. Projects completed and personal milestones should be evaluated to gauge how someone’s career trajectory looks. Overall, professional self-assessment is essential for understanding one’s strengths and areas for improvement, so they can reflect on their experiences and better plan for their future.**

**REFERENCES:**

Buss, S. R. (2003). *3D Computer Graphics: A Mathematical Introduction with OpenGL*. Cambridge University Press.

Moroney, L., & Moroney, L. (2017). An Introduction to Firebase. *The Definitive Guide to Firebase: Build Android Apps on Google's Mobile Platform*, 1-24.

Ribelles, J., López, A., & Belmonte, O. (2010). An Improved Discrete Level of Detail Model Through an Incremental Representation. In *TPCG* (pp. 59-66).