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CS – 499: Computer Science Capstone

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**Enhancement Two: Algorithms and Data Structure**

This artifact is a C++ program developed for an OpenGL-based 3D graphics project, created as part of a computer graphics and visualization assignment. I first completed this artifact in 2022, but I enhanced it in 2025. It uses modern OpenGL practices to render a texture, lit 3D cube with dynamic lighting and camera controls. The code demonstrates the use of vertex and fragment shaders, texture mapping, Phong lighting, and user interactivity through keyboard and mouse input.

I selected this artifact because it highlights my ability to apply algorithms and data structures in a real-time graphics context. Specific components such as the structured vertex data layout, efficient use of arrays and buffers, and matrix transformations demonstrate my understanding of data organization and memory management. I improved the artifact by refactoring duplicated shader compilation code into a reusable function, enhancing texture loading error handling, and optimizing input processing for better control and flexibility. These updates reflect my growth in writing cleaner, more maintainable, and performance-aware code.

I did meet the course outcomes I planned to achieve with this enhancement in Module One, particularly in applying data structures, algorithms, and software engineering principles to solve complex problems. This project allowed me to demonstrate proficiency in organizing and processing vertex data, handling user input, and implementing shader-based rendering. At this time, I have no updates to my outcome-coverage plans, as the enhancements effectively supported my learning goals and aligned with the intended outcomes of the course.

Enhancing and modifying the artifact taught me the importance of clean code structure, modular design, and efficient debugging. I gained hands-on experience with OpenGL's rendering pipeline, shader programming, and texture handling, which deepened my understanding of how graphics systems work. One of the main challenges I faced was isolating and reusing duplicated shader compilation logic, which required careful management of OpenGL resources. I also had to improve error handling for texture loading, which helped me recognize the value of providing clear feedback for debugging. Overall, the process strengthened both my technical and problem-solving skills.