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Lab 8 Report: Z-Buffer Rendering

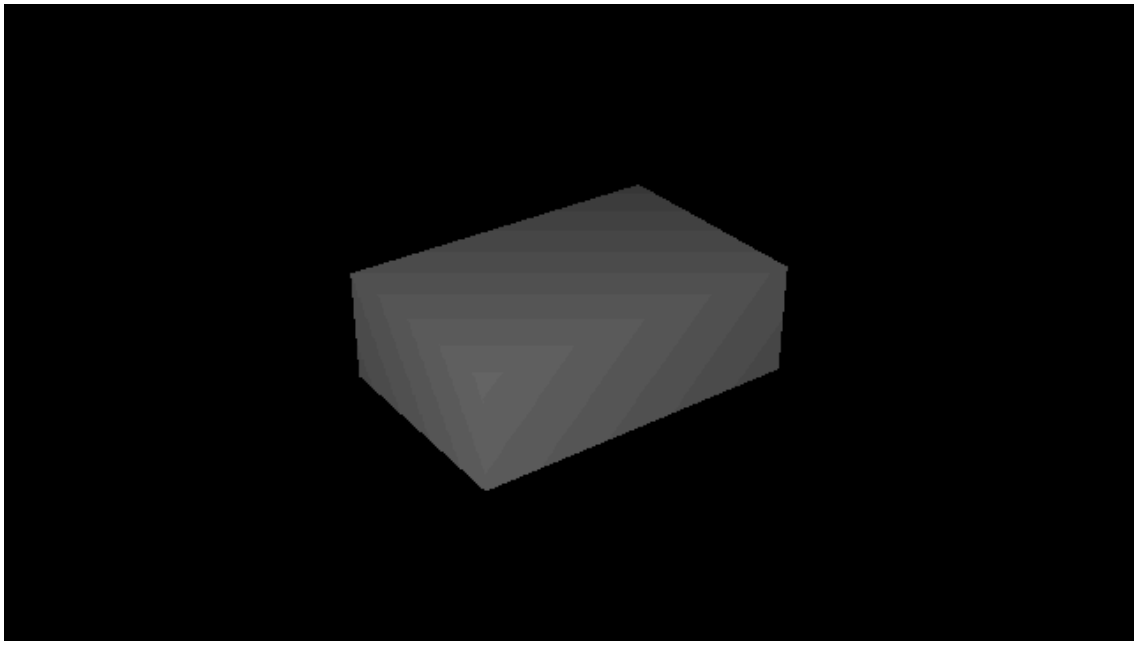
Summary

The purpose of this project was to implement z-buffer rendering for hidden surface removal in a hierarchical modeling system. Z-buffer rendering ensures that only the nearest surfaces are visible in the final image, enhancing the realism of 3D scenes. In this assignment, I implemented z-buffer related functions, updated the scanline fill algorithm, and created various images to demonstrate the functionality of the z-buffer system.

Required Images

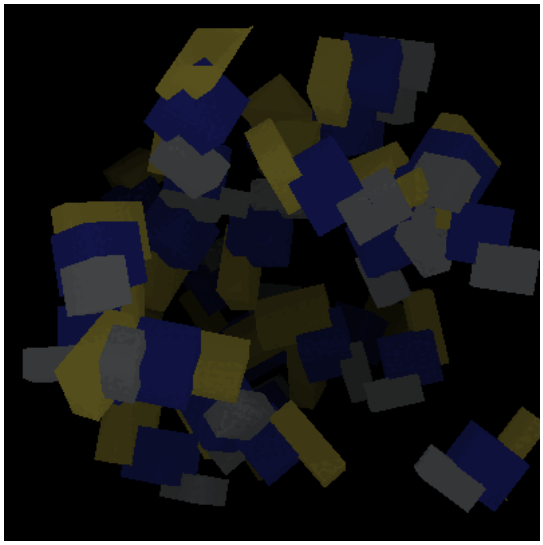
1. Test Image A

Description: This image was created using the ***test8a.c***, which renders a cube with z-buffer shading based on depth. The shading varies from dark to light, indicating depth, with the formula **(r, g, b) = (1-z, 1-z, 1-z)**. This test confirmed that the z-buffer is correctly handling hidden surface removal.



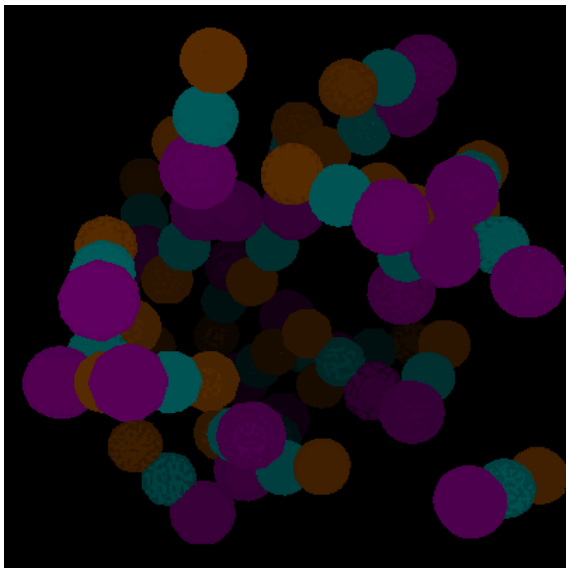
2. *Cubism Example*

Description: This animation sequence was generated using the ***cubism.c*** program. The colors of the polygons were modified based on depth to demonstrate the z-buffer's effectiveness. The shading formula used was **(r, g, b) = s*(red * (1-z), green * (1-z), blue * (1-z))**, with **s** as a scale factor to brighten the colors. The animation shows smooth transitions and correct hidden surface removal as the cube rotates.



3. *Creative 3D Image of Working Z-Buffer*

Description: This 3D image was created to further demonstrate the z-buffer's functionality. It includes multiple overlapping spheres, ensuring that only the closest surfaces are rendered. The image highlights the effectiveness of the z-buffer in maintaining the correct visual hierarchy of objects.



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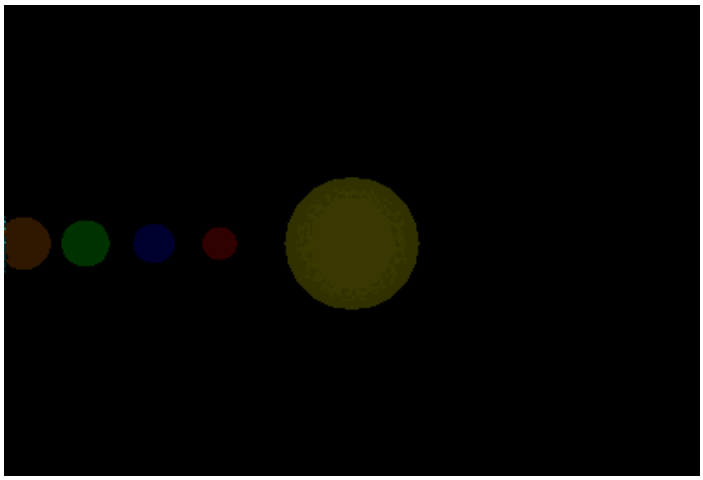
Extensions / Portfolio

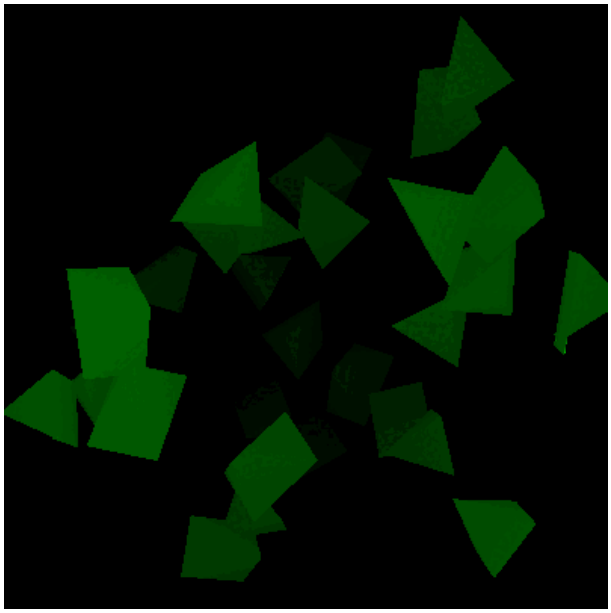
1. **Solar System**

   Description: This creative 3D model depicts a vibrant and dynamic solar system, with spheres representing various celestial bodies. The use of z-buffer rendering ensures accurate depth and hidden surface removal, bringing the model to life with realistic spatial relationships and visual clarity.



2. **Rotation Green Gems (Pyramids)**

   Description: This captivating 3D model showcases a series of rotating pyramids, elegantly demonstrating complex motion and spatial dynamics. The z-buffer rendering technique ensures precise hidden surface removal, highlighting the intricate interplay of shapes as they change their orientation, creating a mesmerizing visual experience.



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Reflection

Implementing the z-buffer rendering system was a challenging but rewarding experience. It deepened my understanding of hidden surface removal and the importance of depth information in rendering realistic 3D scenes. The project also improved my skills in managing complex data structures and algorithms. I particularly enjoyed seeing the immediate visual improvements in rendered scenes as a result of implementing the z-buffer.

Acknowledgements

I would like to recognize the following for helping me complete this assignment:

- **Instructor and Course Material:** Professor Maxwell's lecture notes and videos provided me with guidance and reference materials for implementing the algorithms. My chat with him during office hours helped me mitigate issues with shape clipping when the images go out of bounds.
- **Classmates:** N/A
- **Online Resources:** Various online tutorials and articles from sites like W3schools on scanline and barycentric algorithms contributed to my understanding of the concepts.