Individual Reflection Report - Wisyal

1. Personal Contribution Analysis

My primary responsibility was the development of the majority of the rendering pipeline and scene management. I implemented the hierarchical scene structure and instancing system that allowed efficient placement of trees, rocks, grass, and flowers across the environment. I also designed and integrated the farmhouse and the “forest wall” system, which provides a natural boundary to the world.

In terms of advanced rendering, I developed the heightmap-based terrain system to represent mountainous regions at the edges of the environment. I also implemented multiple lighting techniques, including Phong lighting with ambient, diffuse, and specular components, as well as fog to enhance atmospheric realism. To ensure realism, I implemented shadow mapping, texture management for the ground plane, and integrated ambient environmental audio (birds chirping and wind).

Additionally, I was responsible for performance optimization, including random instancing for vegetation distribution and shader tuning. Finally, I handled the majority of the technical documentation to ensure that our work was well-presented and technically sound.

2. Technical Challenges

One of the most difficult challenges I encountered was generating and aligning the heightmap terrain with the flat plane environment. Initially, the terrain appeared either offset or floating above the ground, which required careful recalibration of coordinate scaling, height offsets, and normalization of vertex positions. Debugging these transformations deepened my understanding of world vs. local coordinate systems.

Another challenge was optimizing scene rendering. With hundreds of objects (trees, grass, flowers), performance could easily degrade. I solved this by using instancing for repeated models and minimizing redundant draw calls. Debugging shadow mapping was also difficult, as incorrect depth buffer usage caused artifacts and unintended shadow placement, but careful analysis of the light space matrix and depth comparisons resolved this.

3. Learning Outcomes

This project significantly improved my practical understanding of computer graphics. I gained hands-on experience with hierarchical scene graphs, heightmap terrain generation, shadow mapping, and shader programming. I also deepened my understanding of OpenGL buffer

management (VBO, VAO, EBO) and the interplay between CPU-side setup and GPU-side execution.

I also learned how critical performance optimization is in graphics applications. Features like LOD and instancing are not just theoretical — they make the difference between an interactive experience and an unplayable one.

4. Team Collaboration Reflection

Our two-member team worked efficiently. I took the lead on the bulk of the system, while my teammate focused on dynamic lighting systems (flashlight and day/night cycle). While our contributions were uneven in terms of workload, communication was clear and consistent. I frequently shared updates and progress, and my teammate integrated their work smoothly with my systems. The experience showed me the importance of modularizing components, so that independent features can be merged without major conflicts.

5. Future Development Ideas

If we had more time, I would expand the terrain system to support dynamic tessellation and real-time LOD, allowing infinite terrain exploration. I would also integrate advanced post-processing effects such as SSAO, bloom, and depth of field. Adding physics-based interactions, such as wind-blown grass or destructible rocks, could enhance immersion. Finally, VR support and a user-friendly scene editor would make the project even more interactive and engaging.