EE/CprE/SE 4910 WEEKLY REPORT 4

10/3/24 – 10/10/24

Group number: **40**

Project title: 3D Gaussian Splatting With Dynamically Raytraced Lighting

Client: Jackson Vanderheyden & Brian Xicon

Advisor: Simanta Mitra

Team Members/Role:
Ethan Gasner - Documentation Manager.
Kyle Kohl - Communication Manager.
Jackson Vanderheyden - Graphics Scope Manager.
Brian Xicon - Machine Learning Scope Manager.
Luke Broglio - Schedule Manager.

- **Weekly Summary:**

For this Fourth report, similarly to the previous week, we continued to refine and modify our requirements to fit with the activities from class. Additionally, we started the basics of our prototyping phase, with some team members conducting basic test projects to better understand how we will implement our project while others worked on sample data set collection. As we move forward, we eventually plan to integrate the insights gained from our initial tests to enhance our overall project strategy.

- **Past week accomplishments**

Ethan Gasner: This week I spent time learning more about the specific machine learning algorithms and techniques that we will use on the gaussians to obtain the enhanced data set. We are planning on using stochastic gradient descent in which our input “points” will be each sample scene and its data points. I am looking into the set up of this problem and if that is feasible or if we need to alter the set up. I also solved a simpler SGD problem as coursework for ComS 474 that overlapped with our planned optimization.

Kyle Kohl: I continued to expand my knowledge of raytracer and graphics via books and programming. Along with continuing to communicate with team members to ensure concise and clear work expectations. Lastly, expand my general knowledge of PyTorch.

Jackson Vanderheyden: This week, I broke down all of the necessary ray-object intersections, ray-box, ray-triangle, and ray-Gaussian, and the math concepts needed for our ray tracer. I also took notes on primary ray generation, the first essential step in a ray tracer. On top of that, I also broke

down the architecture of the ray tracer into a context diagram, product use case diagram, scenarios, function requirements, and non-functional requirements to better scope the ray tracer and identify all initial necessary functionality. I have also created a blank Unity project to start work on the project.

Luke Broglio: This week I finished the first phase of the traditional Unity raytracer where it is now capable of rendering spheres placed into a Unity scene. This practice has helped me to learn about the tools and technology we intend to use for our project. I also started to work on creating a raytracer which renders point clouds similar to gaussians. This can serve as a proof of concept for our project to help show what we are trying to accomplish to advisors and anyone else who is interested.

Brian Xicon: This week my main goal was to go further into researching specific code examples of what we are trying to accomplish. This consisted of researching important aspect of machine learning in relation to our project like stochastic gradient descent and I also found the datasets we will be using to train our machine learning models.

- **Individual contributions**

NAME	Individual Contributions	Hours this week	HOURS cumulative
Ethan Gasner	Researched sample data sets and explored how to apply Stochastic Gradient Descent to our project.	6	24
Kyle Kohl	Learned more about UNITY, how it works and general features that could be applied to our project.	6	24
Brian Xicon	Looked into specific code examples of aspects of our machine learning side of the project as well as found datasets to use for training.	6	24
Jackson Vanderheyden	Broke down ray-object intersections, primary ray generation, and defined ray tracer scope using multiple system diagrams.	6	24
Luke Broglio	Finished the first phase of traditional raytracer in Unity and started to make a small point cloud rendering raytracer in Unity to serve as a proof of concept.	6	24

- **Plans for the upcoming week**

Ethan Gasner: I am planning on continuing to investigate how we will apply Stochastic Gradient Descent to the sample points obtained in this past week. I was not able to update the team website this week, so updating that for both documentation and advisor reasons is a high priority. I am specifically aiming to add all introductory information onto the website as well as revised versions of our previous weekly reports.

Kyle Kohl: I will again continue to expand my knowledge of raytracer and Unity. I am going to work specifically on understanding how the Unity scene data and general understanding how the Gaussian optimization enhances performance and what exactly I will be

Jackson Vanderheyden: Next week, I plan to lay out the initial structure of the ray tracer by creating all necessary scripts. I will start development on the raytraceGetHit compute shader which will determine ray-object intersection. Initially, development will focus on making the ray tracer compatible with Unity's scene data. In the future, I plan to focus my work on raytraceGetHit & raytraceHit (primary for lighting calculations).

Luke Broglio: I am planning to finish up my proof of concept point cloud raytracer by Tuesday so it can be presented at our advisor meeting. I also intend to continue work on the traditional Unity raytracer I started to gain practice with implementing features like reflection and shadows using Unity's compute shaders.

Brian Xicon: Next week I want to continue going over examples of code that could be useful for the AI team and I am hoping to also begin the implementation of a basic Gaussian optimizer.

- **Summary of weekly advisor meeting**

Our meetings with our advisor are bi-weekly and therefore did not meet with Mitra this week. However, we will need to update our team website before our next meeting to meet Mitra's requirements.