# Lumen-Integrated
DirectX Path Tracer

CIS 565 Final Project

Yiyang Chen, Hanlin Sun, Zhuohao Lin

● Why this project matters?

Lumen technique was first introduced to Unreal Engine 5, it was a combination of many optimization techniques which provided amazing lighting quality.

We will integrate some techniques applied in Lumen into our path tracer, in order to render scenes in real-time.
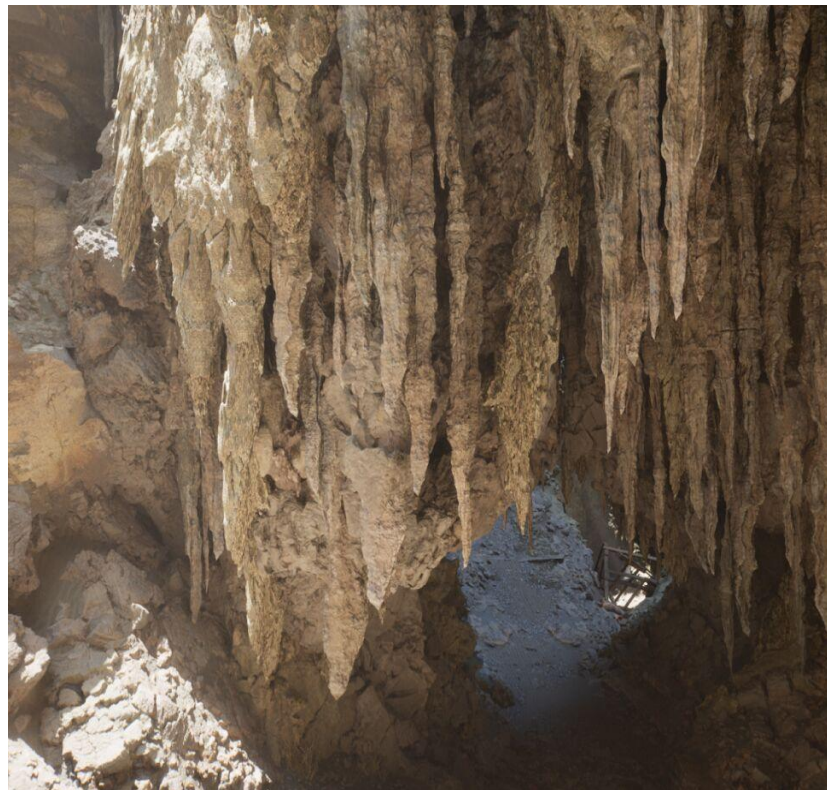
- **Signed Distance Field**
  - The main goal of this technique is to accelerate the intersection computation.
  - Instead of ray tracing we will use ray marching, and the length of step in each iteration can be guided by SDF.
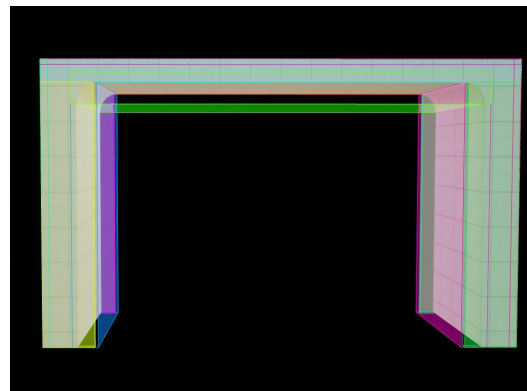- **Screen Space Tracing**
  - We will trace rays first in screen space before falling back to 3D ray marching to accelerate light computation.
- **Surface Cache**
  - It's an automatic parameterization of the nearby scene's surface.
  - It is used to quickly look up lighting at ray hit points in the scene.
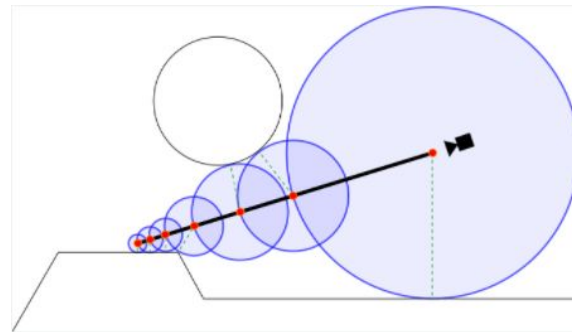
Ray marching with SDF

Mesh cards visualization

Milestone & Final

- **Milestone 1 :** Nov 16
  - Framework
  - Mesh SDF
- **Milestone 2 :** Nov 28
  - Global SDF
  - Screen Space Tracing
- **Milestone 3 :** Dec 5
  - Surface Cache
- **Final :** Dec 12
  - Integrate all techniques
  - Performance analysis

Resources
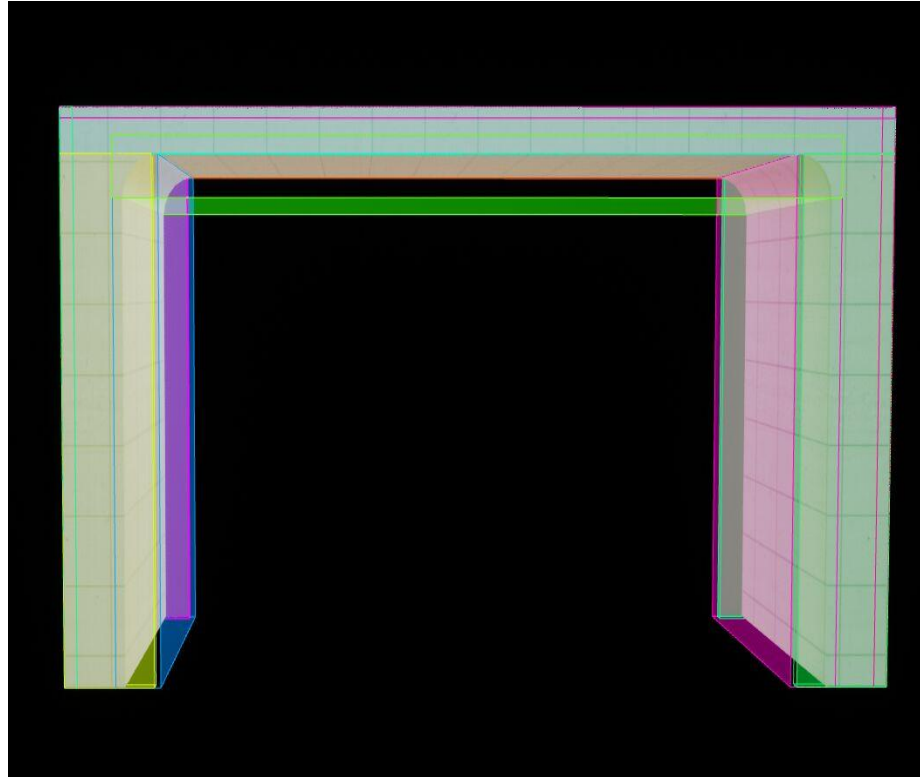
- API: DirectX
- References:
  - UE5 document
  - UE5 source code
  - NVIDIA GPU Gem 3: Signed Distance Field

  - Siggraph 2022 : Lumen Technique

- Third-party code: 2019 DXR Project

● Surface Cache

Surface cache is used to provide the position and direction of the light sampling, to reduce the basic component of the light information buffer.

It was generated offline.

- ## Mesh Signed Distance Field

This approach allows us to leverage instances for storage and decreases memory usage.

This technique is used to accelerate the intersection computation process, can use ray marching to optimize running speed.

References:

[Unreal 4.27 document](#)
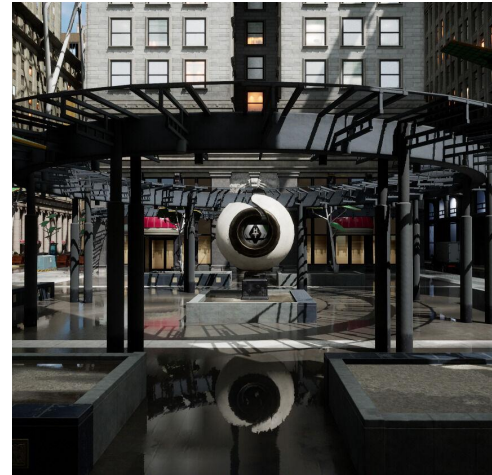
[NVIDIA GPU Gem 3: Signed Distance Field](#)

- ## Global Signed Distance Field

The global distance field merges all mesh distance fields into a set of clipmaps centered around the camera. This is used to accelerate intersection computation.

- ## Screen Tracing

Lumen features trace rays against the screen first, before using a more reliable method if no hit is found.

Reference: Lumen Implementation Analysis