Spheres, LODs, Occlusion, Frustum, Grass & Baking

Simple Graphical Optimization Techniques for (Mobile) Games

Lartu (@martulartu, www.lartu.net)
Optativa (optativa.github.io)
28Y24

Spheres & Skyboxes

Problem

Rendering Infinite Landscapes is Very Expensive

Examples

Halo

(https://jessebartel.substack.com/p/the-beauty-of-skyboxes-feeling-small)

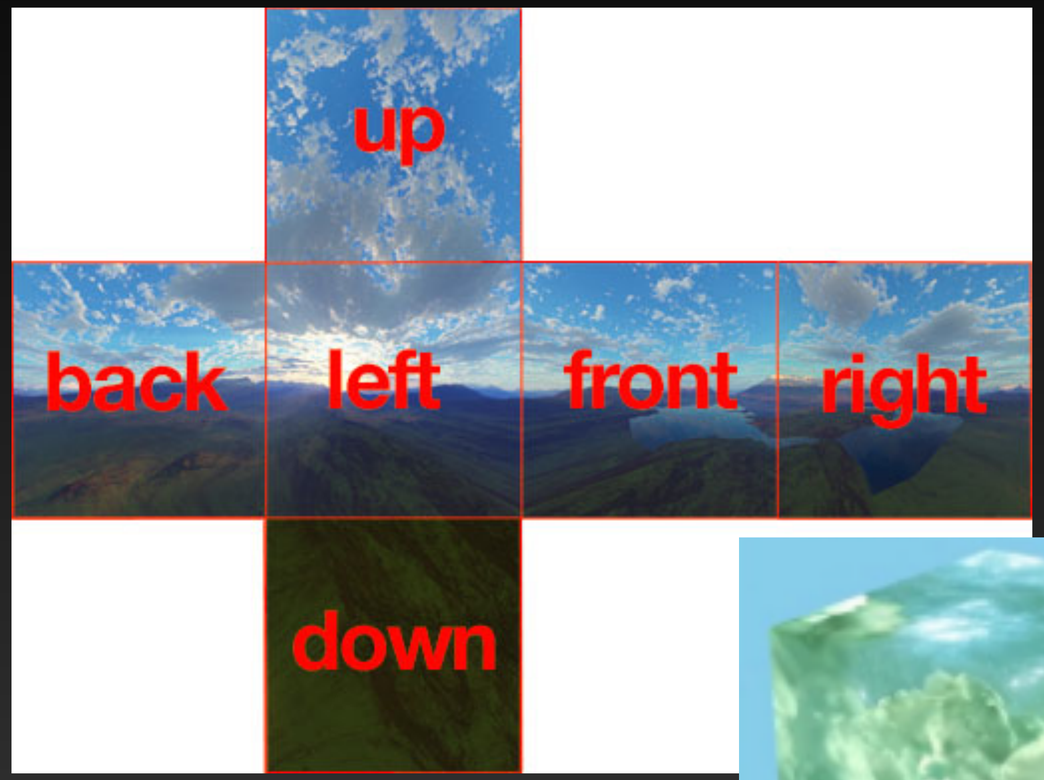
Examples

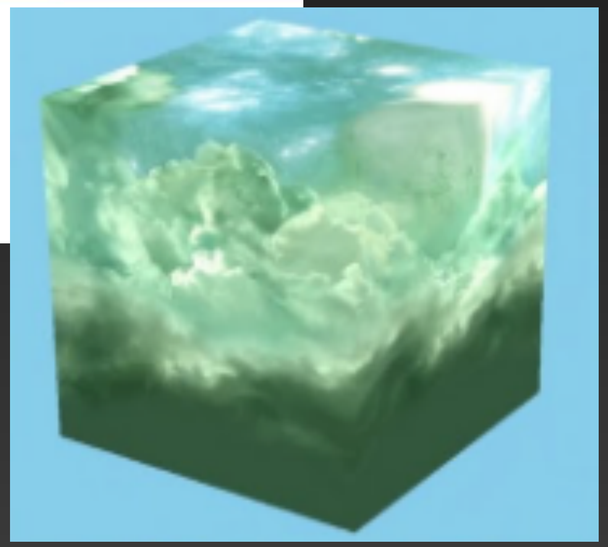
Skyrim

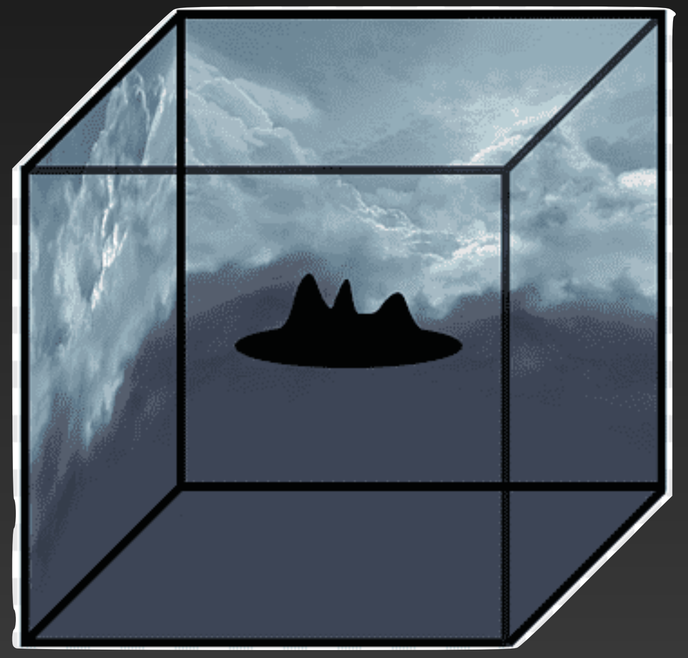
(https://jessebartel.substack.com/p/the-beauty-of-skyboxes-feeling-small)

Solution

Skybox







Skybox

- Pros:
  - Very Efficient
  - Easy to make
- Cons
  - Edges might be visible
  - Usually implemented at an infinite distance from the camera
    - Far Away
    - Not Parallax
    - Doesn’t collide with geometry

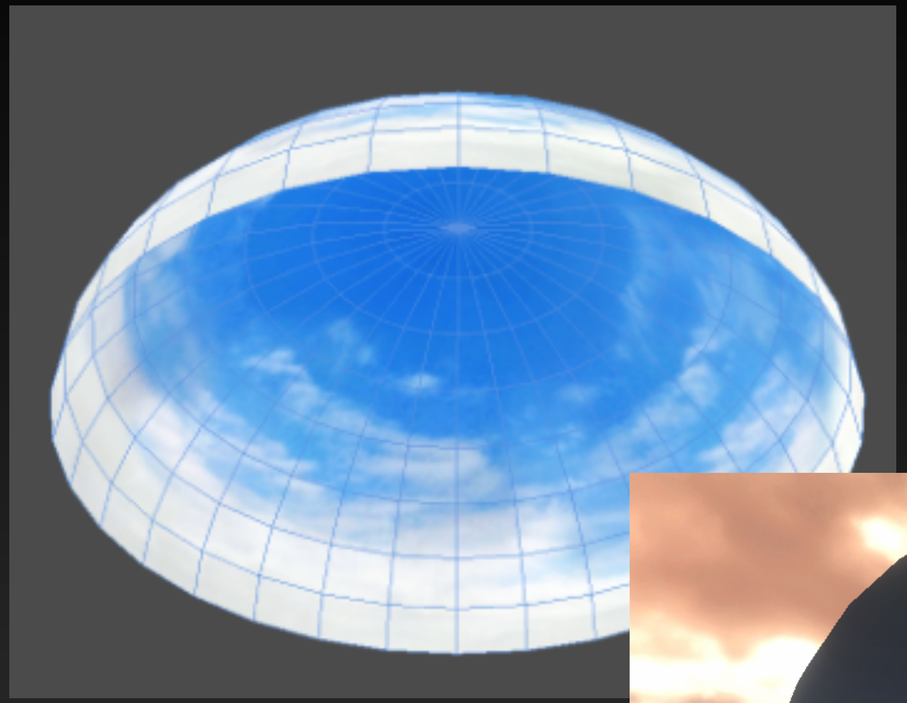
Case Studies: Skybox

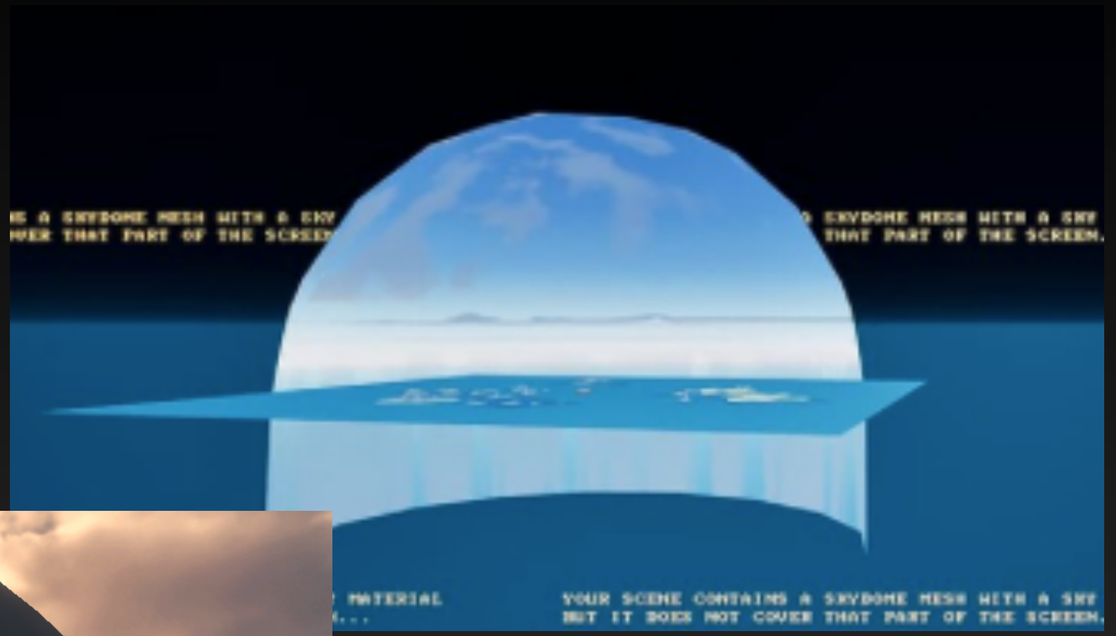
Skybox: Eterspire (Beta II)

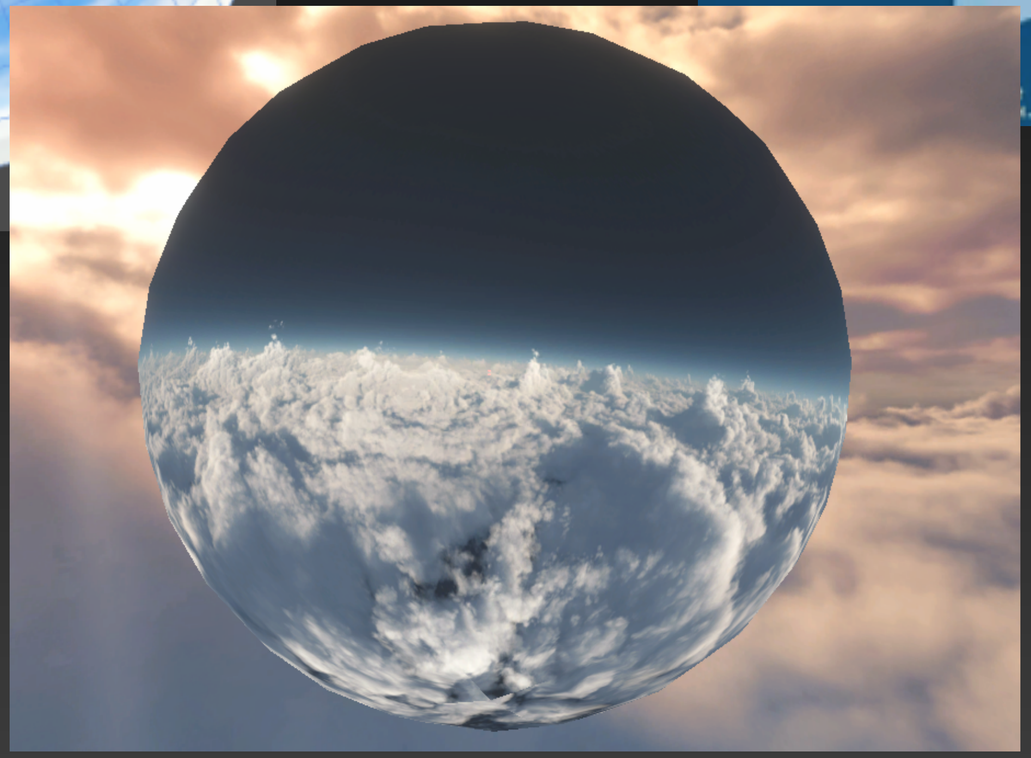
Skybox: Eterspire (Beta II)

Skybox: Eterspire (Beta II)

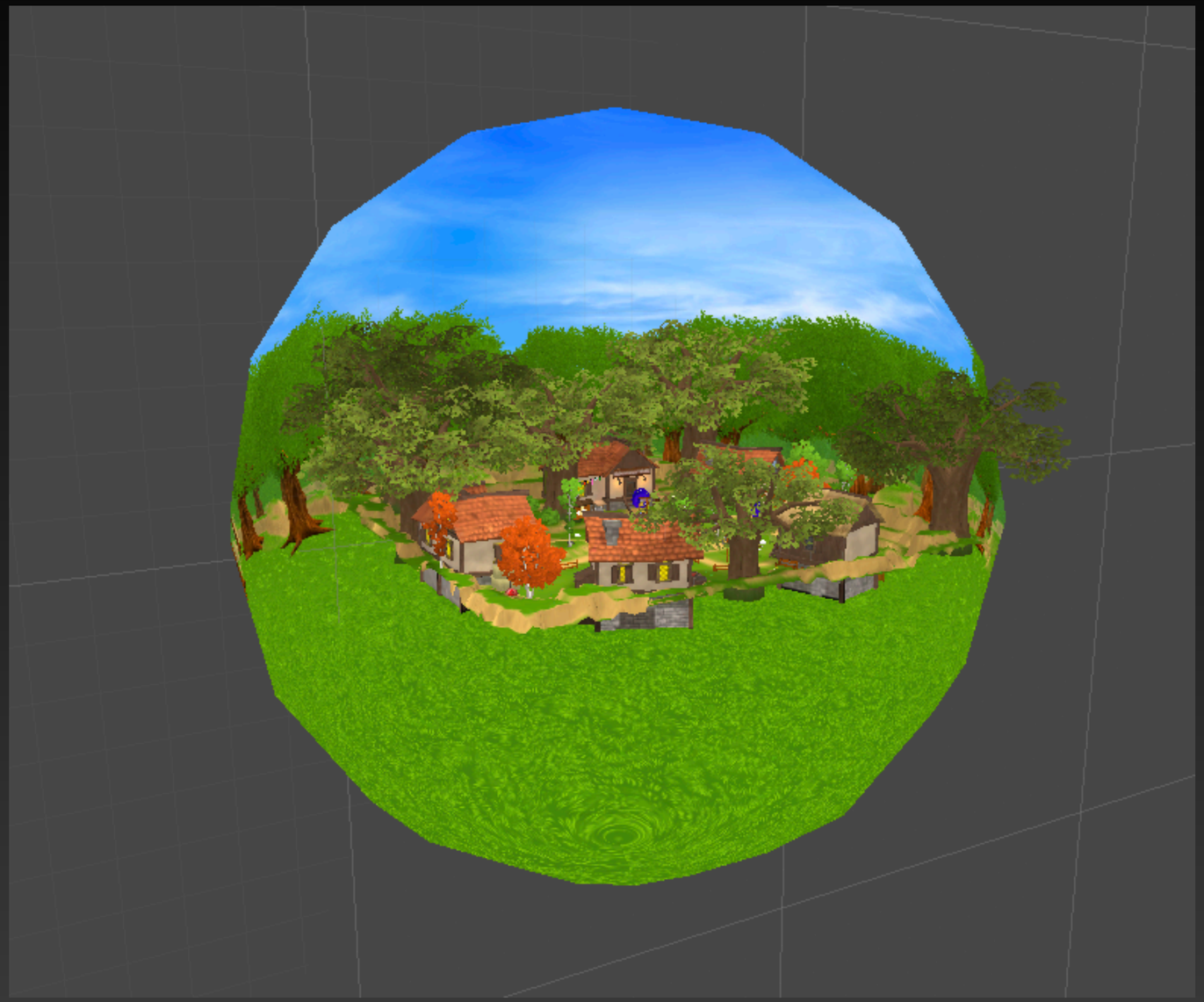
Skydome

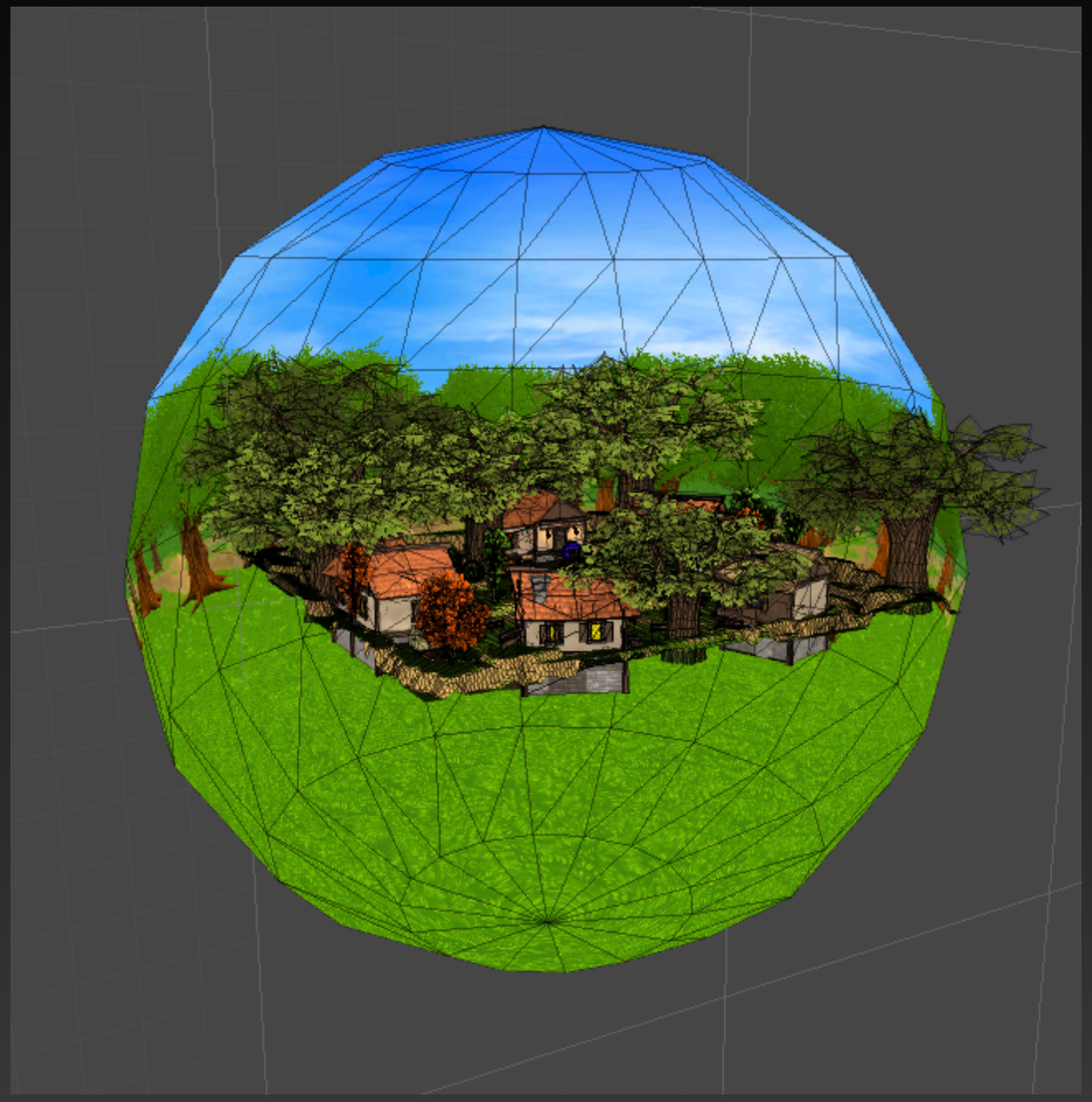



THAT PART OF THE SCREEN.
MATERIAL
YOUR SCENE CONTAINS A SKYDOME MESH WITH A SKY
BUT IT DOES NOT COVER THAT PART OF THE SCREEN.



Skydome





Skydomes

- Pros:
  - Real Geometry
  - Separable Parts
  - Parallax
- Cons:
  - More Expensive
  - Harder to make
  - Terrains tend to be square

Case Studies: Skydome

Skydome: Eterspire (Journey Anew!)

Skybox vs Skydome Results

Skybox vs Skydome Results

LODs

Problem

Rendering Scenery is Expensive

Examples

Guild Wars 2

Examples

Skyrim

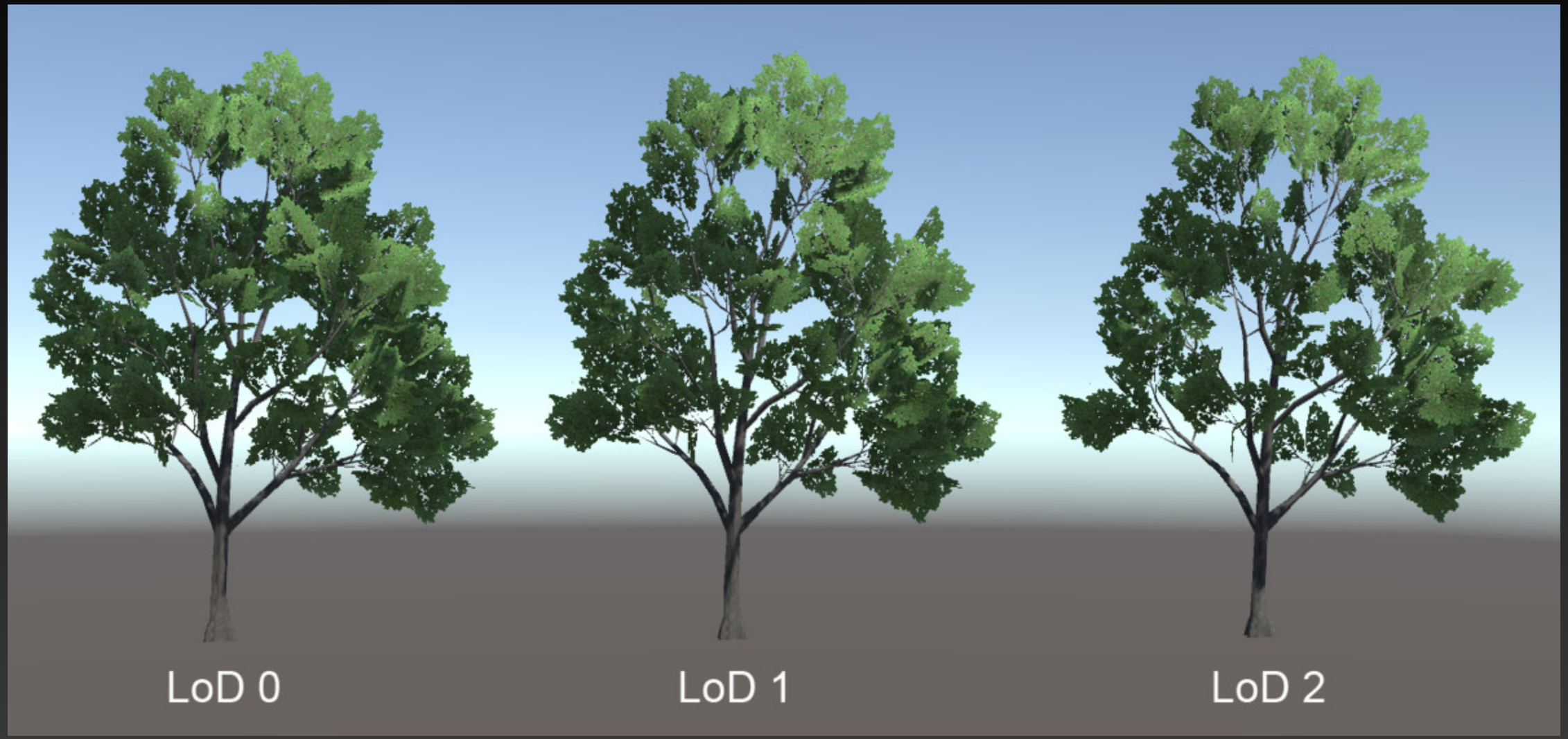
Examples

(This was a video)

LODs

- Pros:
  - Improved performance
- Cons:
  - Lots of work (can be automated by engine or modeling software)
  - Adds to game size
  - Visual Pop-Ins

LODs



LODs

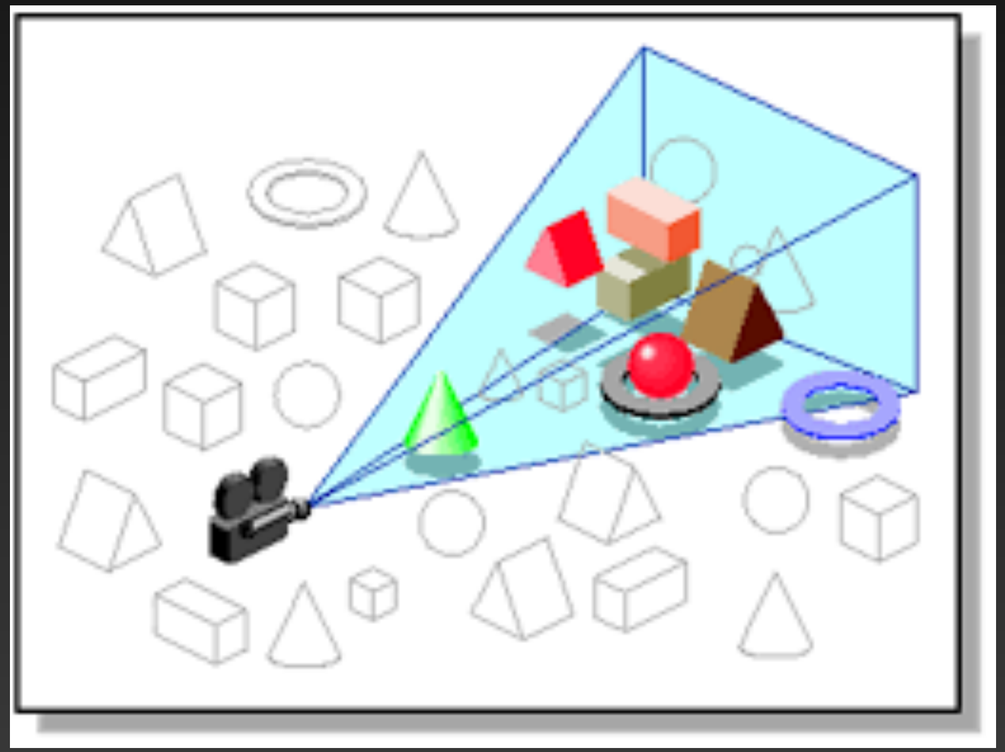
Culling

Problem

Rendering Occluded Geometry is Wasteful

Frustum Culling

- Technique used to optimize rendering by excluding objects outside the camera’s view frustum (FoV).

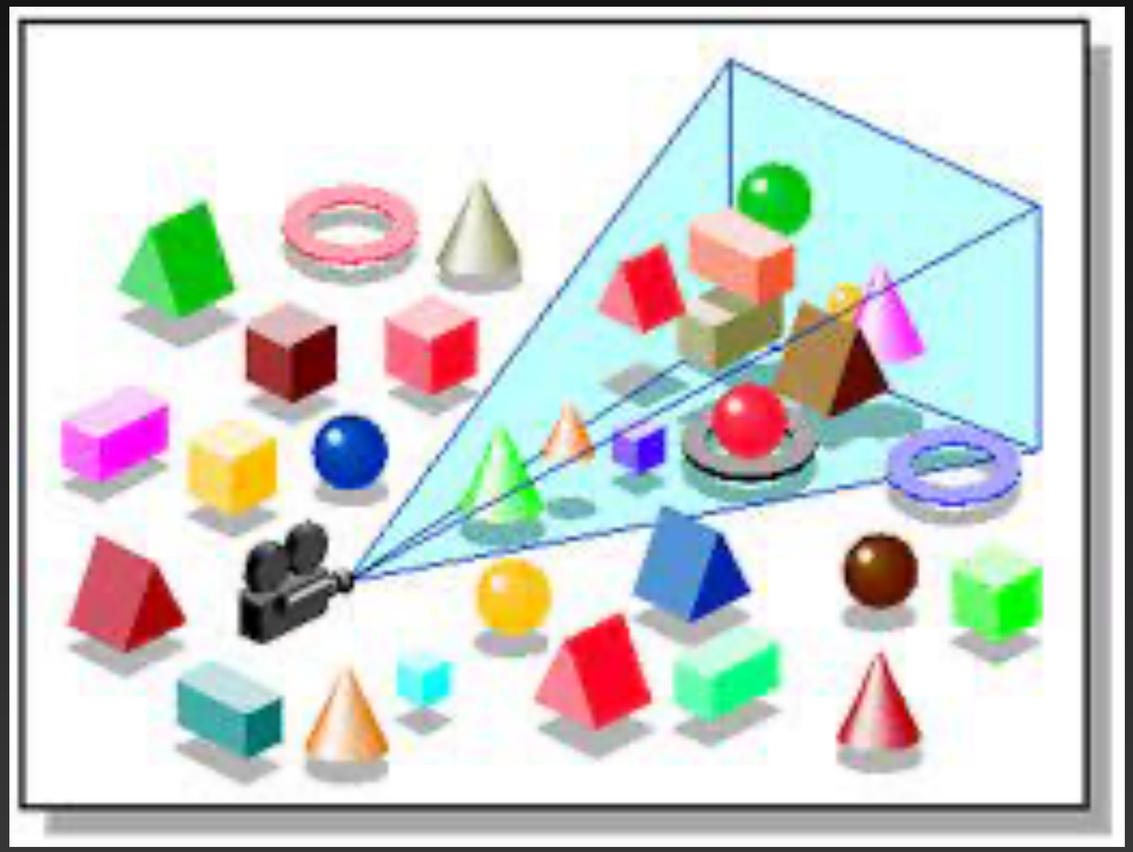


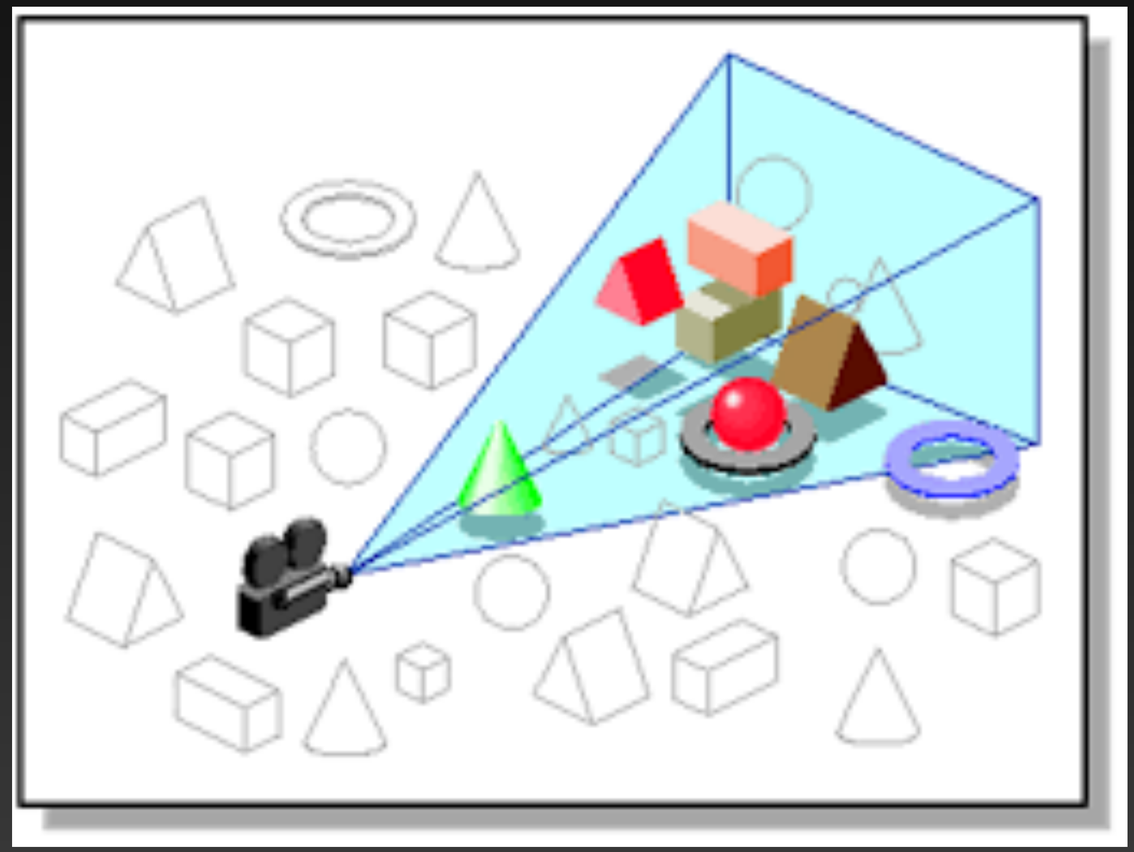
Frustum Culling

- Pros:
  - Reduces Draw Calls
  - Improves Performance
  - Generally Built-In
- Cons:
  - Doesn’t occlude
    - This might be very expensive on noisy scenes!
  - May render objects almost completely outside frustum

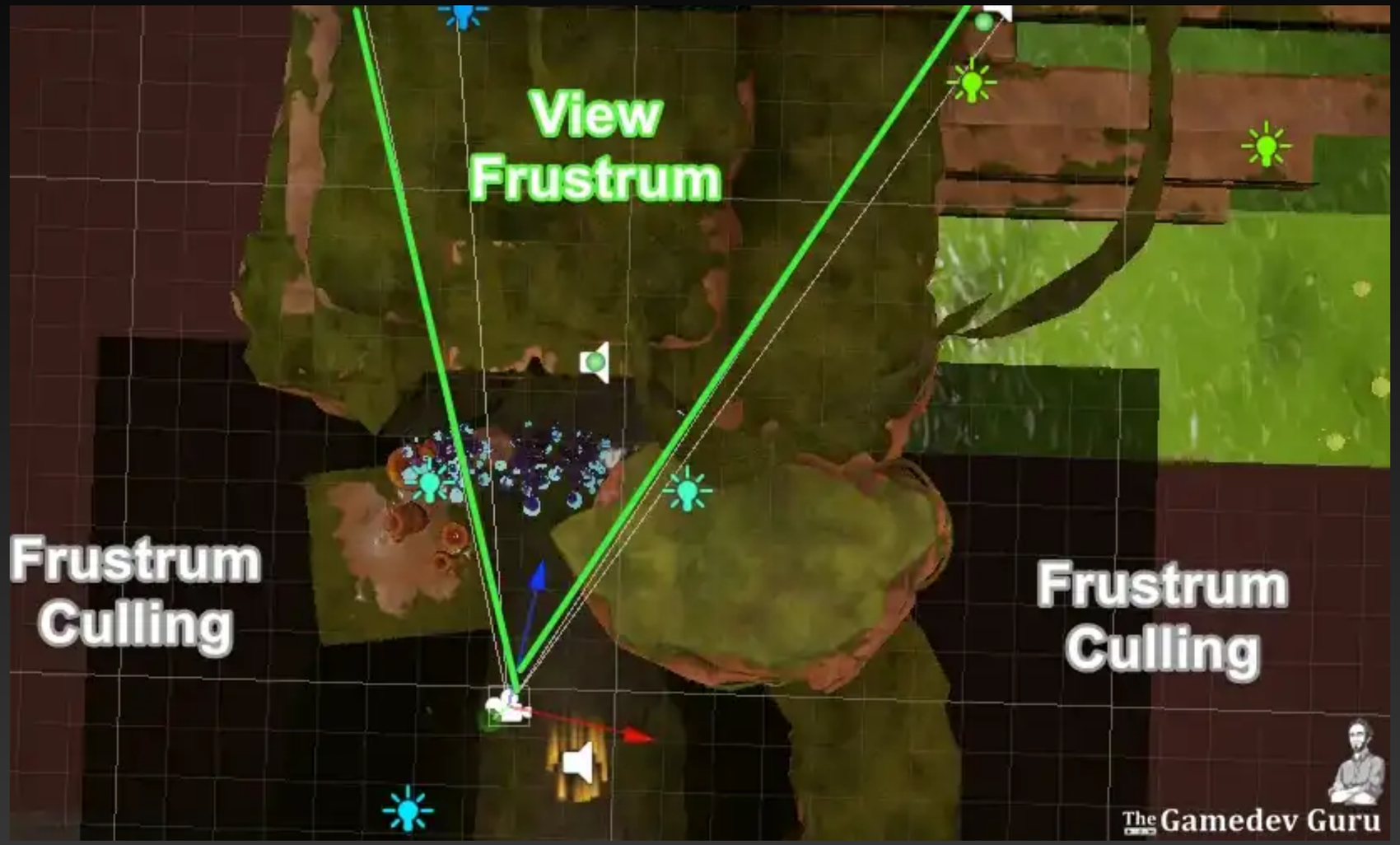
Frustum Culling

- May render objects almost completely outside frustum



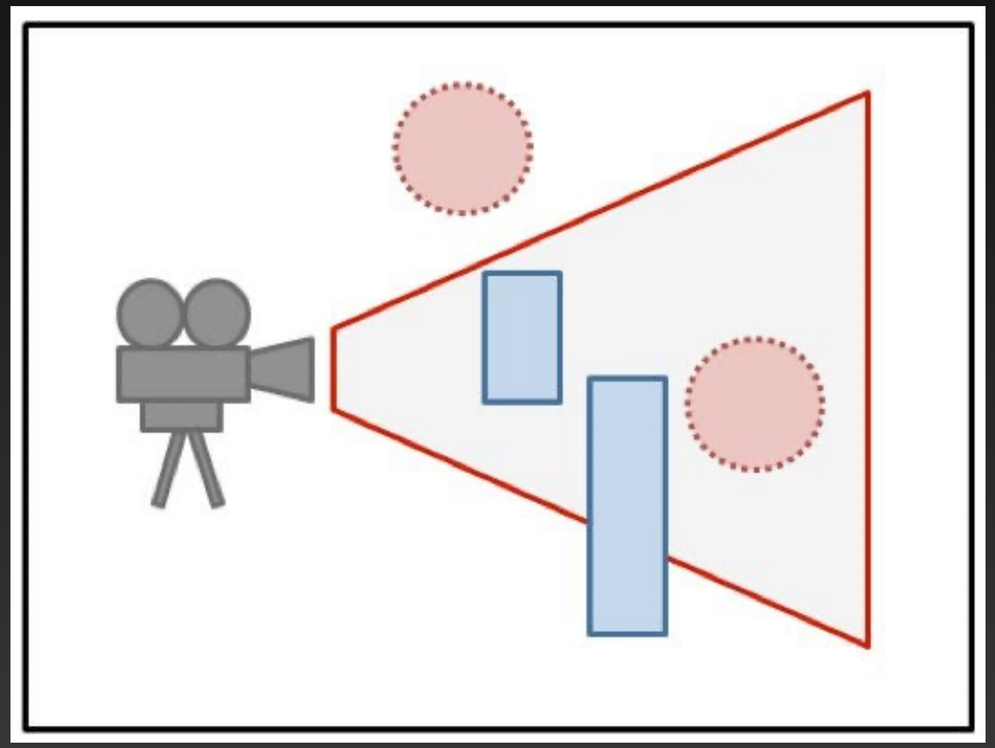


Frustum Culling



Occlusion Culling

- Technique used to optimize rendering by excluding objects not visible to the camera because they are blocked by other objects.

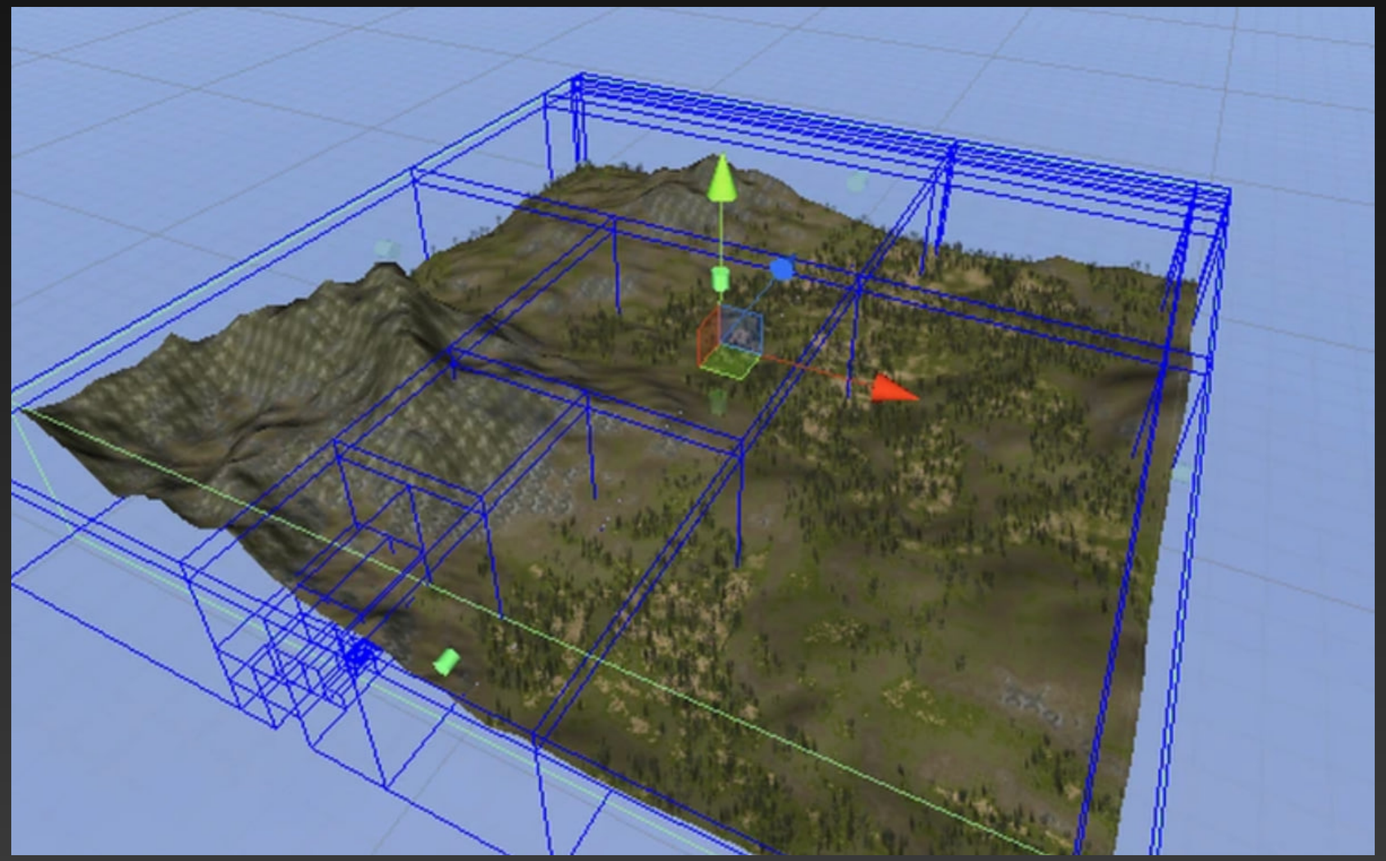


Occlusion Culling

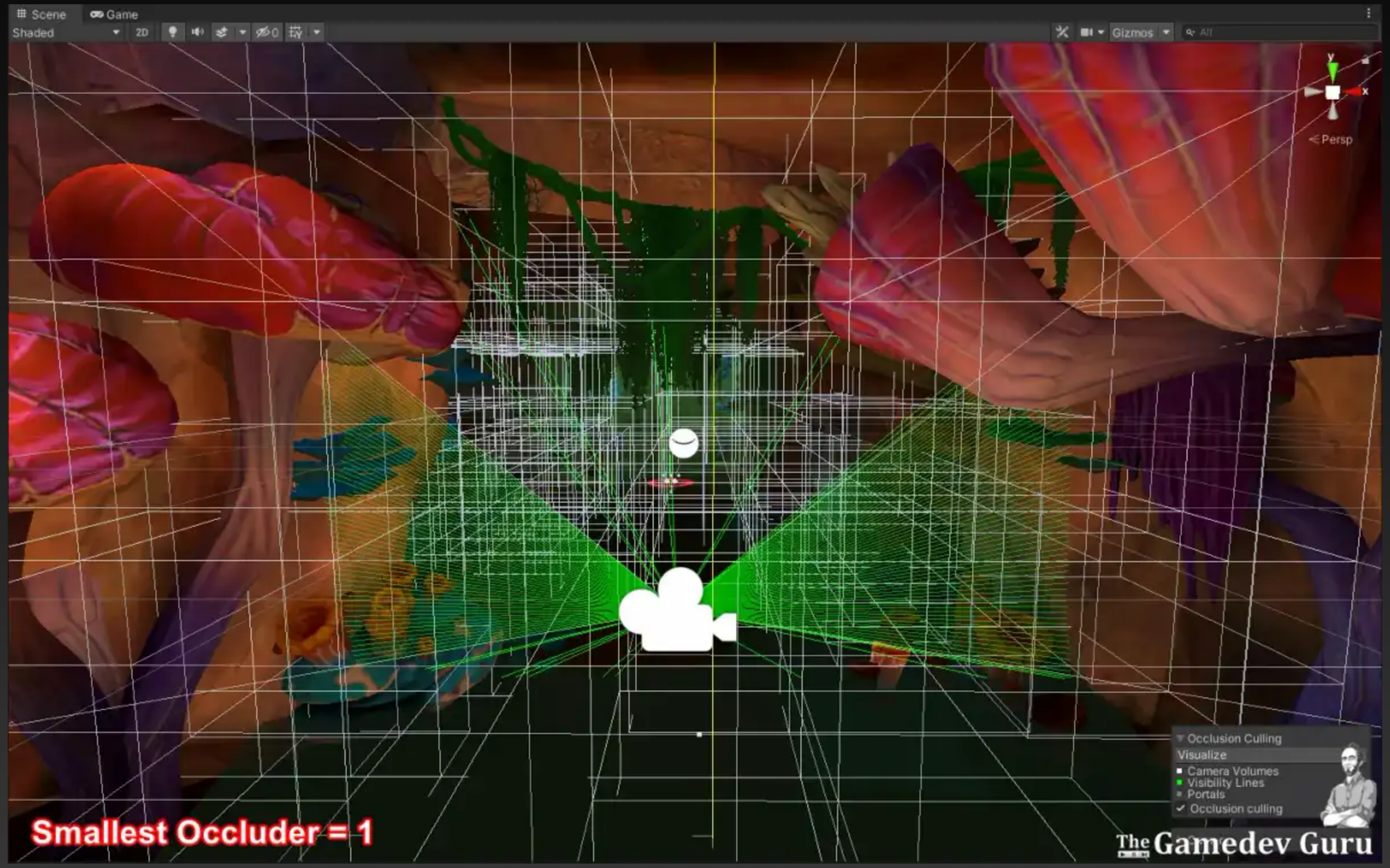
- Pros:
  - Reduces Draw Calls
  - Improves Performance
  - Real-time Optimization
- Cons:
  - Complex to set up
  - Requires maintenance
  - May introduce computational costs
  - Occluders must generally be static geometry

Occlusion Baking

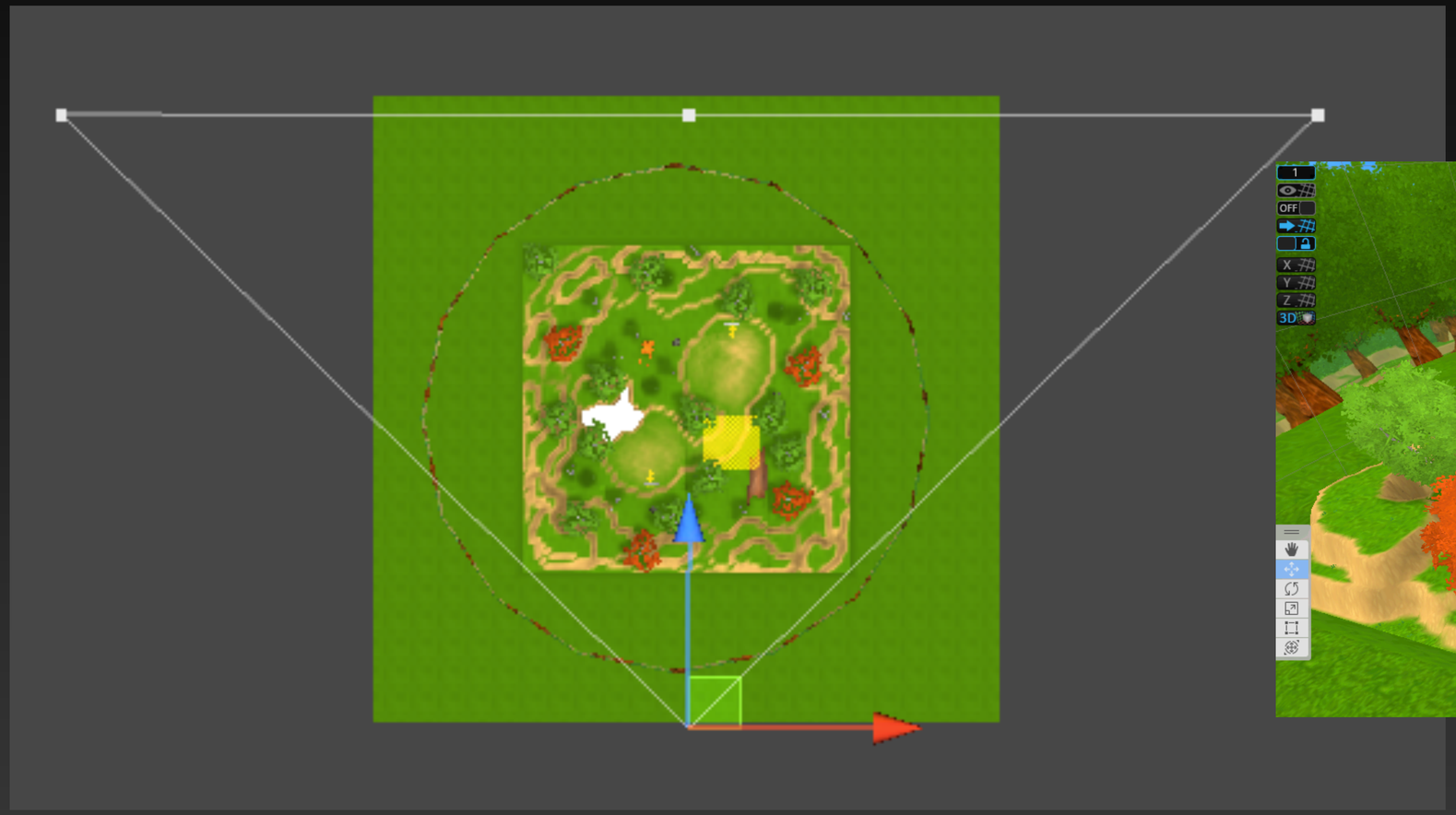
- *Unity divides the Scene into cells and generates data that describes the geometry within cells, and the visibility between adjacent cells.*



Occlusion Baking

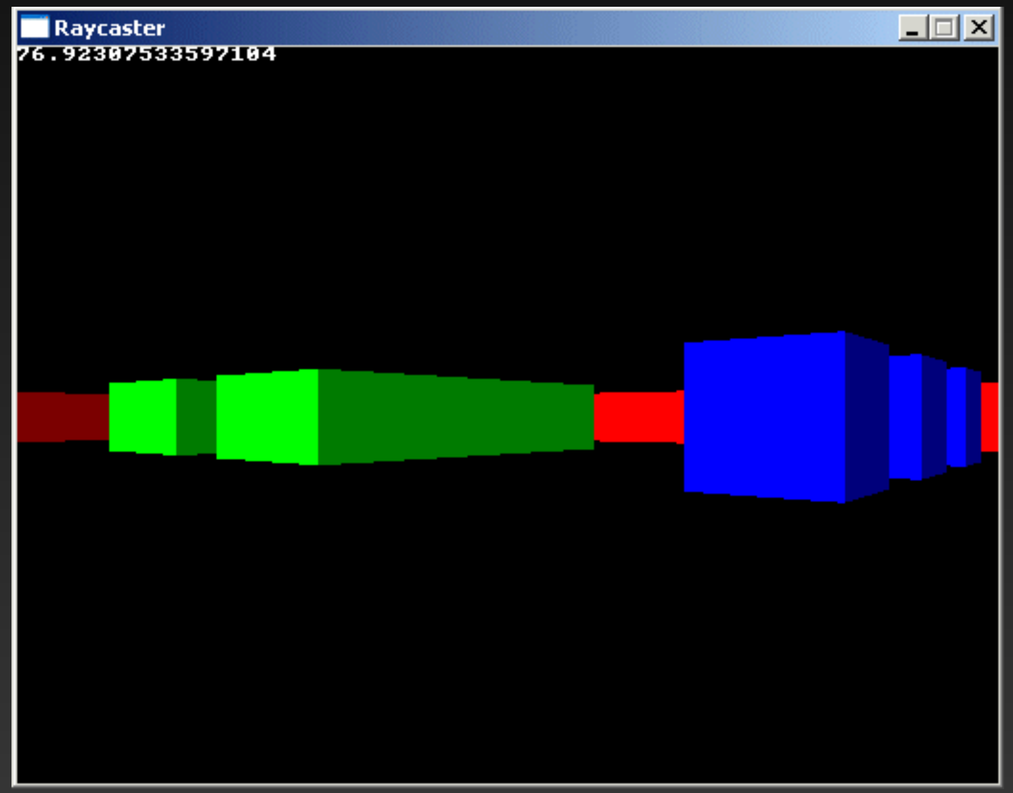


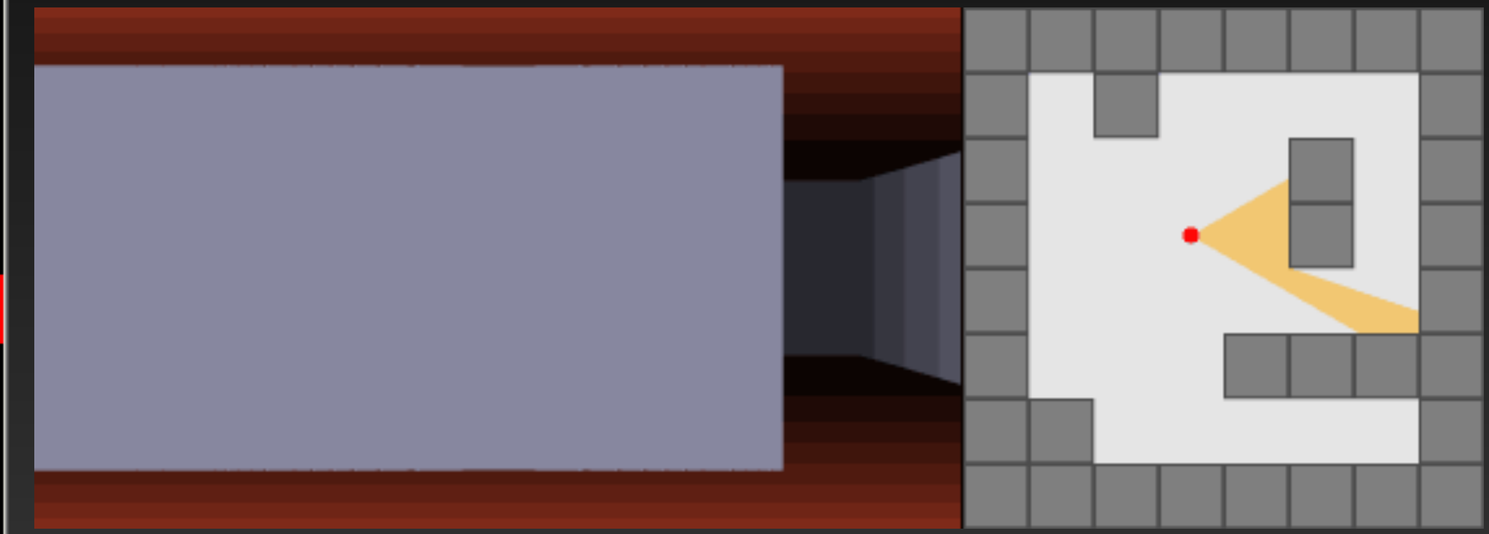
Frustrum-contained Scenes



Raycasting

- Doesn’t need occlusion and is generally frustum culled by default.





Open Scenes

Light Baking

Light Baking

- Pros:
  - Realistic Lighting
  - Lower Memory Usage
  - Better Performance
- Cons:
  - Only works on static geometry
  - Costly to set-up
  - Time consuming & high maintenance
  - Textures often very big
  - Artifacts & seams

Dynamic Light

Light Baking

Case Studies: Baked Light

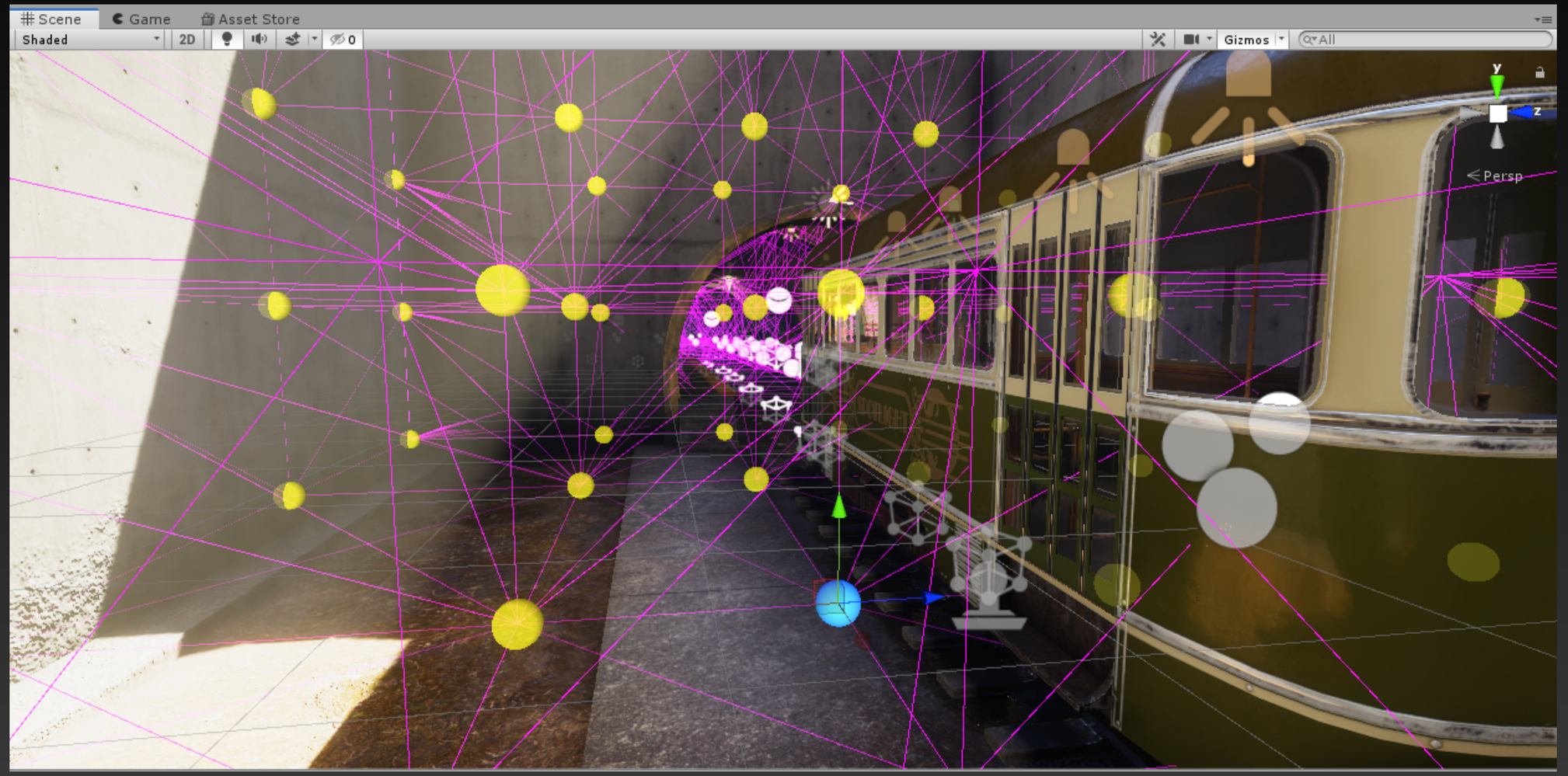
Baked Light

Toram Online

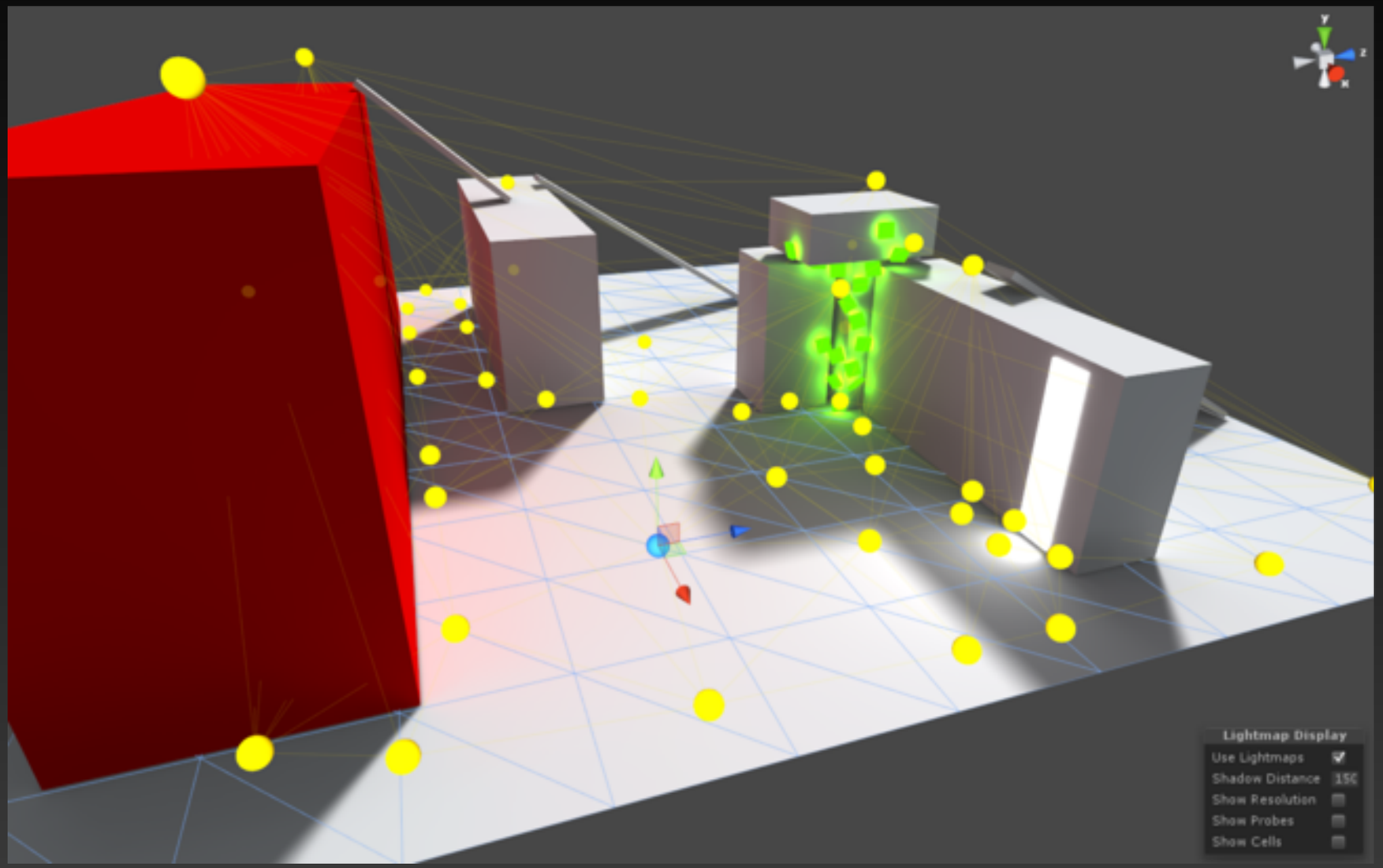
Baked Light

Toram Online

Light Probing



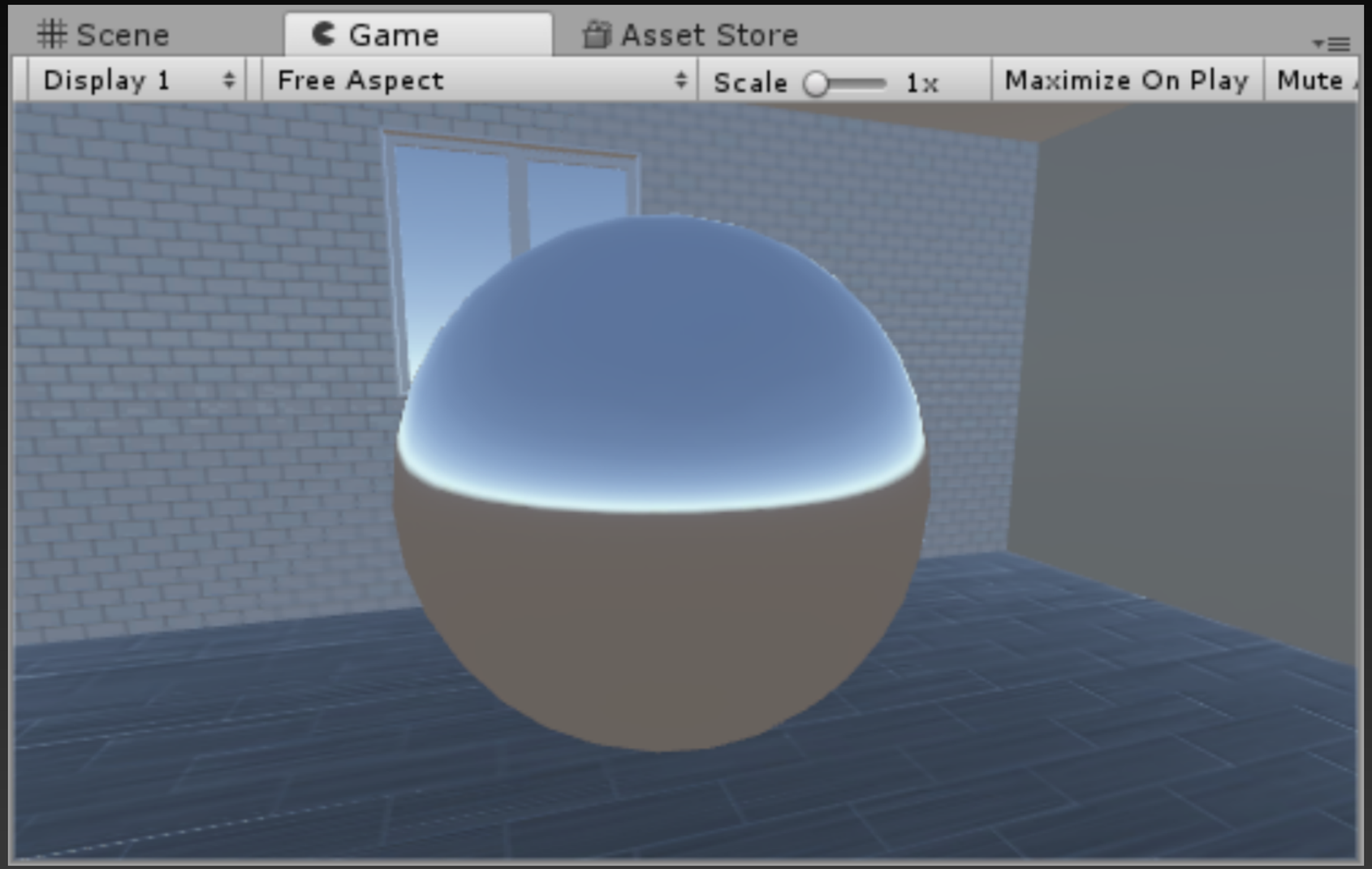
Light Probing



Light Probing

- Pros:
  - Works on dynamic objects
  - Low Overhead
  - Works great on mobile
- Cons:
  - Costly to set-up
  - Time consuming & high maintenance
  - Artifacts

Skybox Reflections



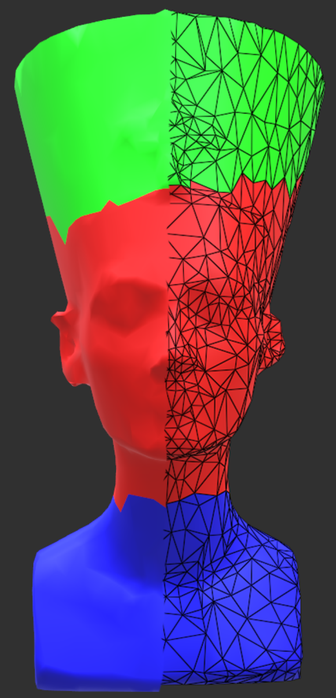
Reflection Probing

Texture Baking

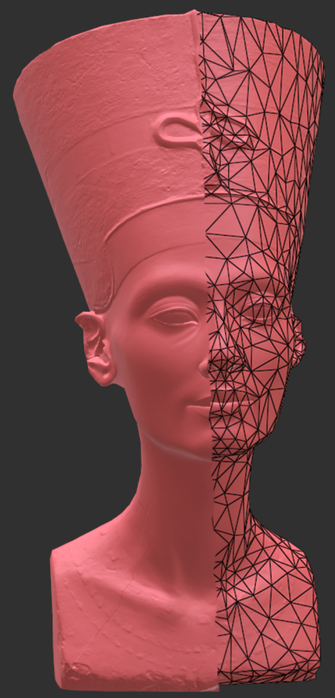
Texture Baking

Highpoly Looking Lowpoly Models from Highpoly Models

2 Mil Polygons



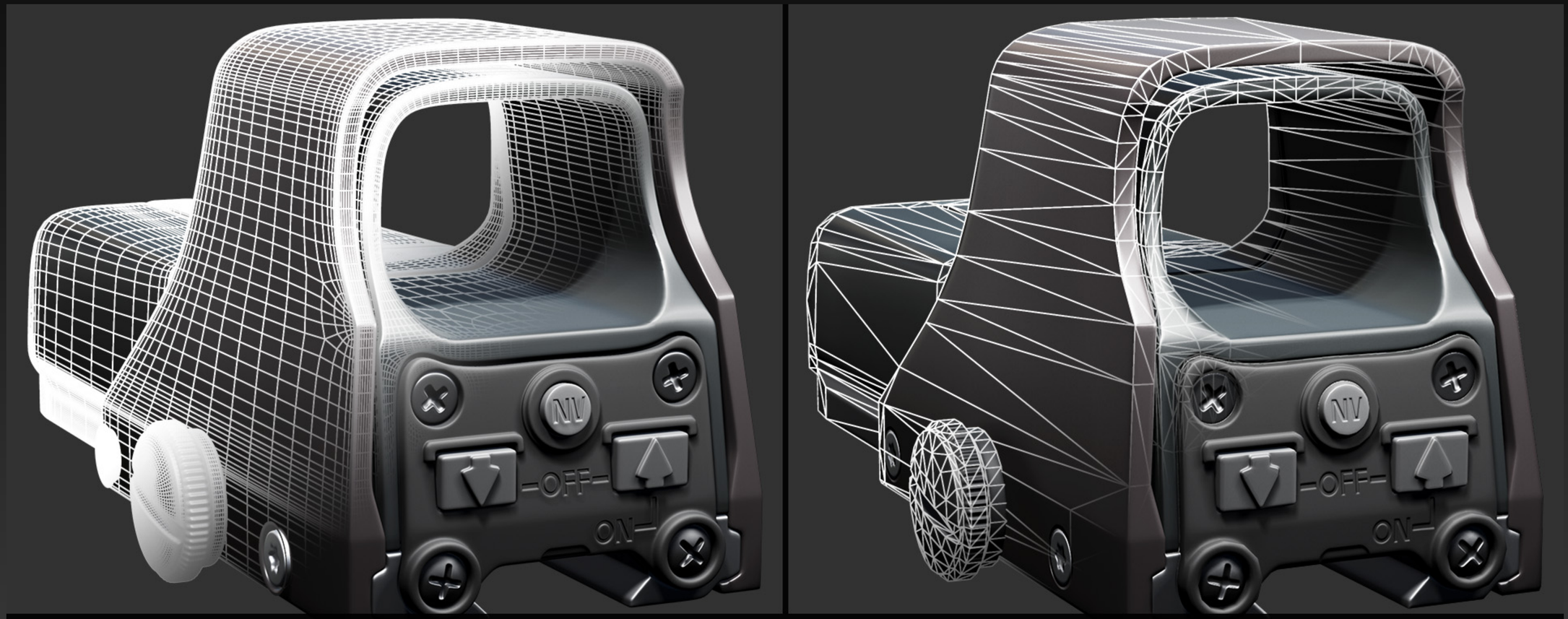
Split Low Poly



Baked Low Poly

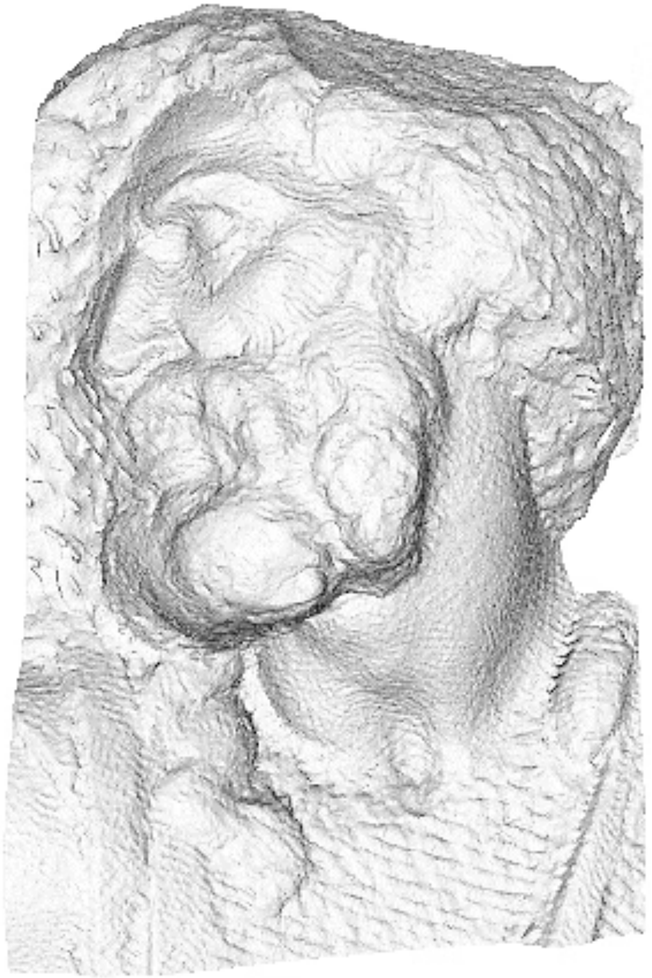
Texture Baking

Highpoly Looking Lowpoly Models from Highpoly Models

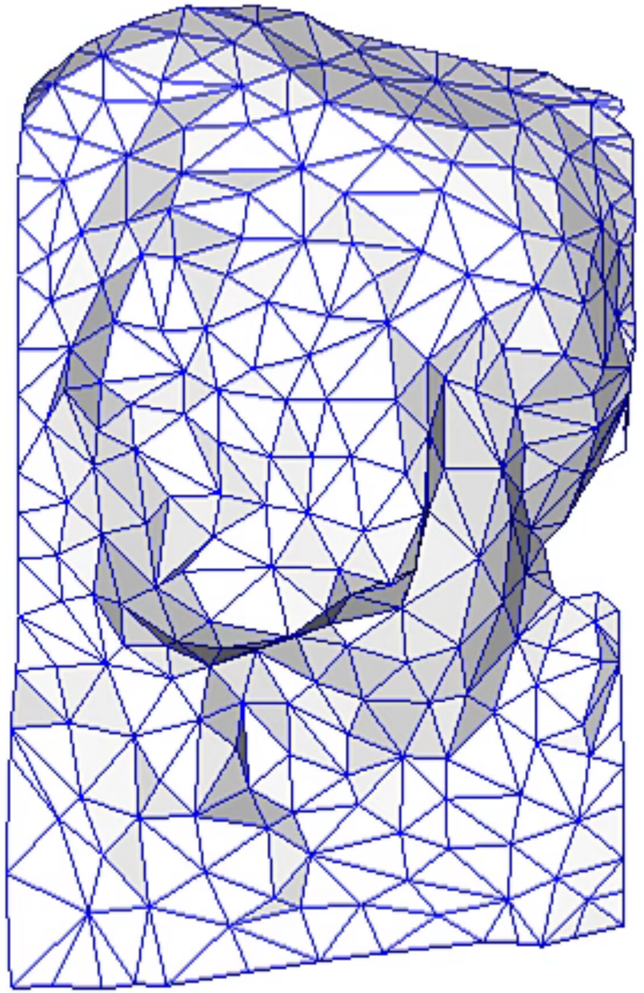


High Poly Source

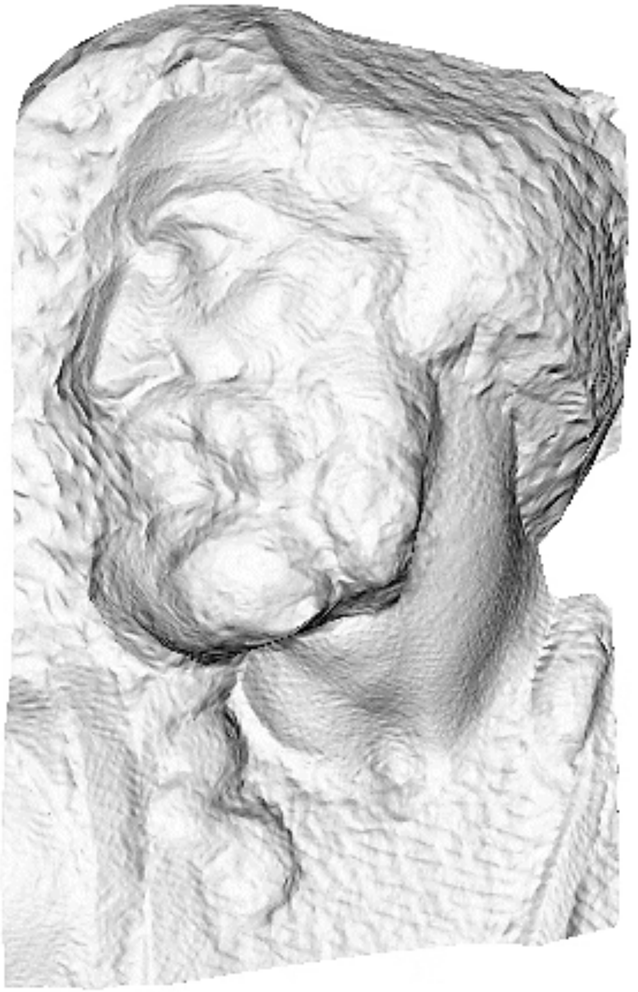
Low Poly Destination



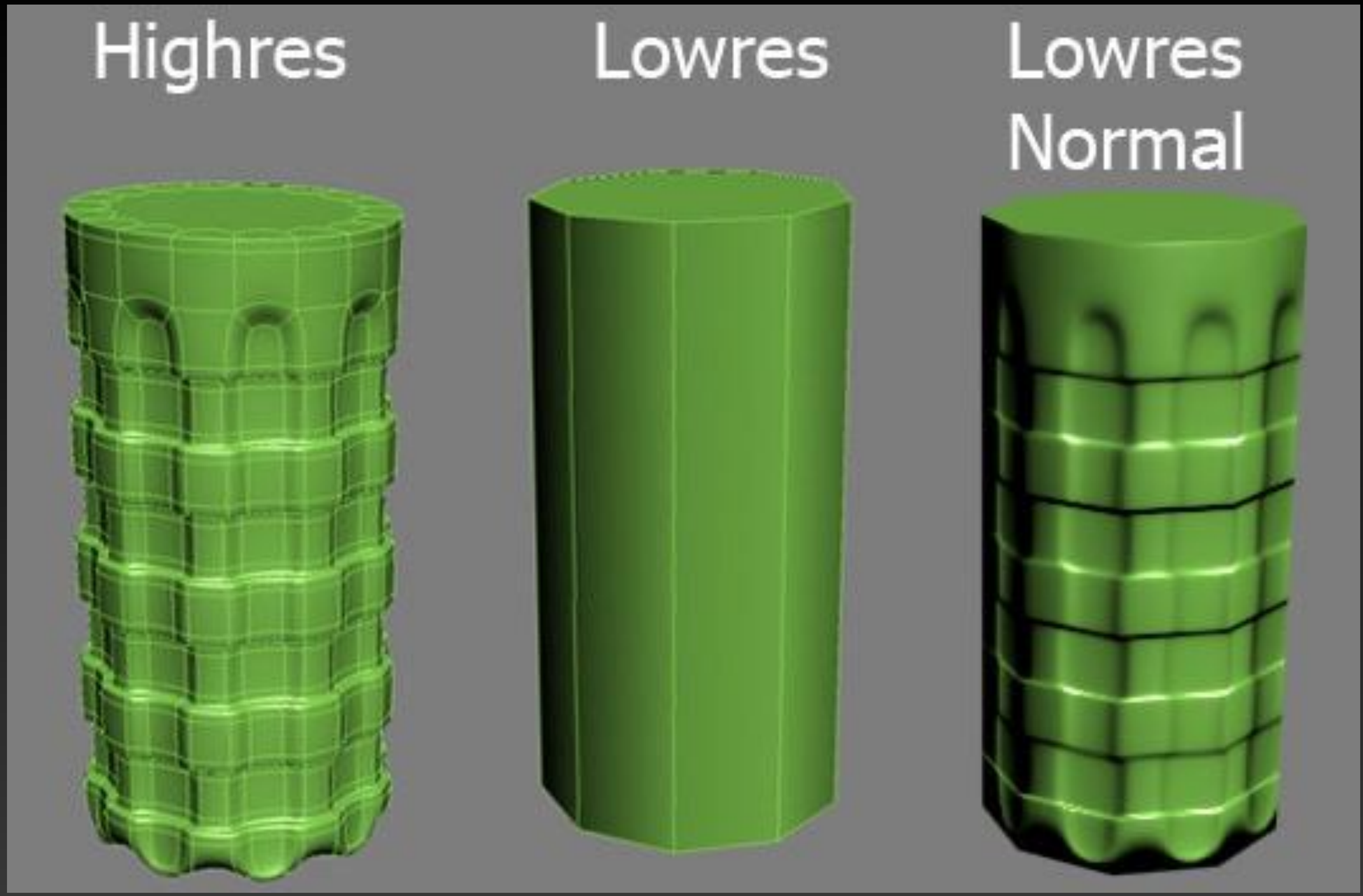
original mesh
4M triangles

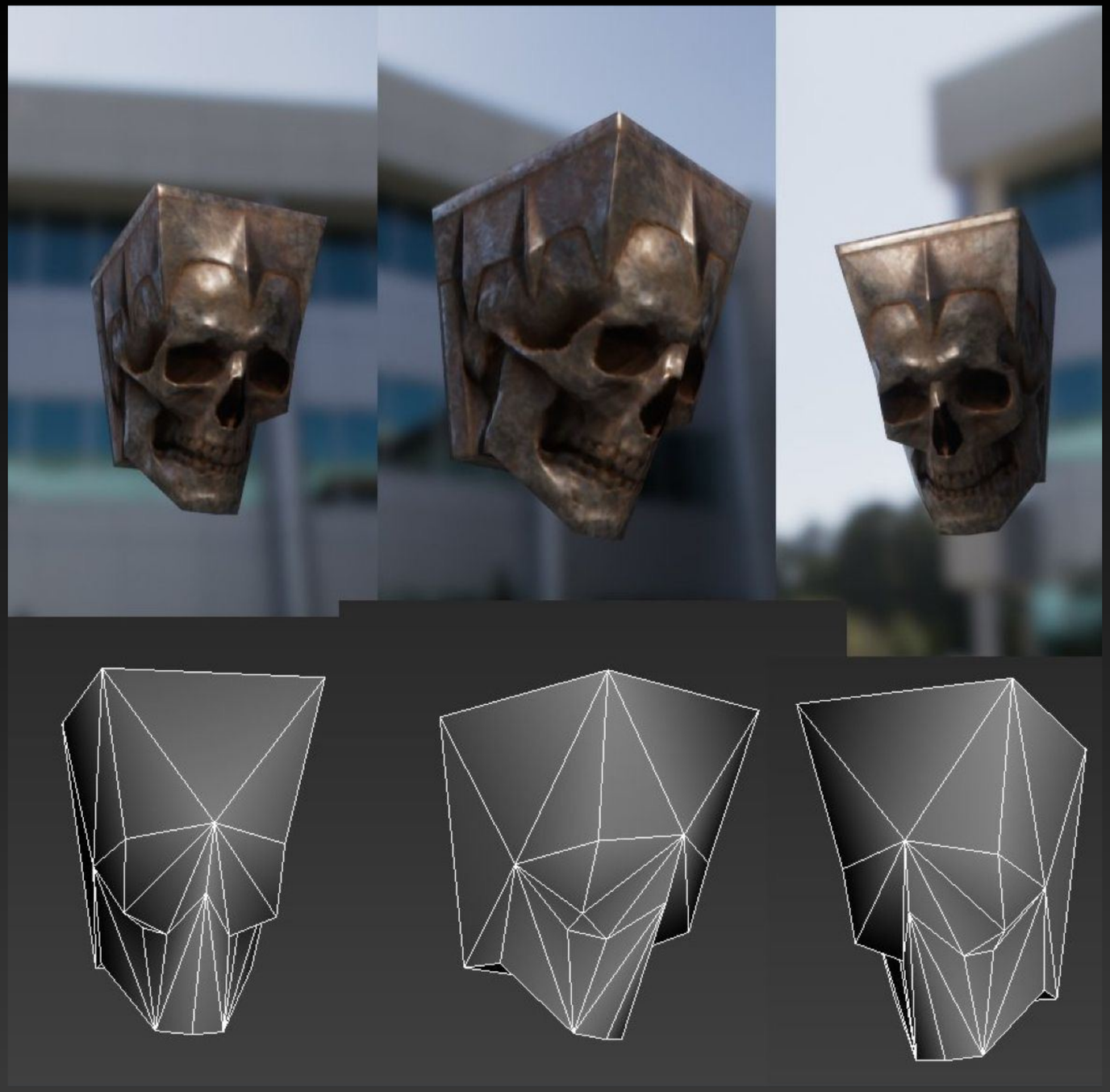


simplified mesh
500 triangles



simplified mesh
and normal mapping
500 triangles


Highres
Lowres
Lowres
Normal



Grass & Details

Triplanar Mapping

Shaders
Depth & Deformation

¿Preguntas?