




Shade

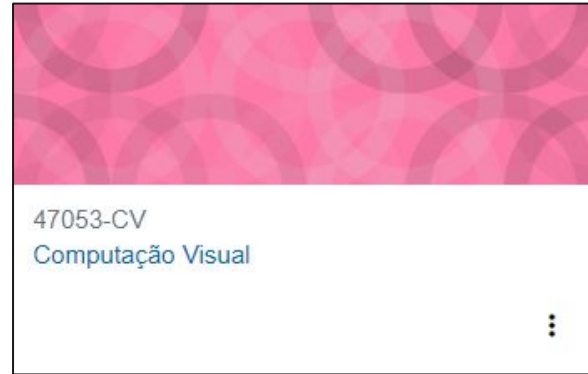
Visual Computation Project

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Context

We chose the project theme based on the type of game that would allow the **incorporation of the greatest number of concepts**, aiming for a comprehensive and enriching approach in Visual Computing.



Objectives

Class

The project applies the theoretical knowledge obtained in the course “Visual Computation”, focusing on:

- Class 05: **3D Viewing, Transformations, and Projections.**
- Class 06: **Illumination and Shading.**
- Class 07: **Geometric Modelling.**
- Class 08: **Textures.**

Advanced

The project applies other advanced computer graphic concepts, with:

- **Physics Simulation.**
 - Raycasting.
 - Colliders and Triggers.
- **World Building.**
- **Shadow Mapping.**
- **Post Processing.**

Project Idea

Puzzle Game with Shadows

Players can **interact with dynamic shadows** on surfaces to reveal or create paths by manipulating objects within the game world, such as:

- Moving Objects.
- Light sources.



Development Approach

Tools, Languages, Engine



Unity

A cross-platform game engine for creating interactive 2D and 3D experiences.

Programming Language: C#



Blender

An open-source 3D computer graphics software tool for 3D modeling, animation software, and more.

Computer Graphics Topics

Course

01

Transformations

Manipulate objects in the 3D space by moving or rotating.



Computer Graphics Topics

Course

02

Projections

Change between projections:

- Perspective Mode.
- Orthographic Mode.



Computer Graphics Topics

Course

03

Light Sources

Different types of light sources.

- Directional Light.
- Point Light.
- Spot Light.



Point Light



Spot Light

Computer Graphics Topics

Course

04

Materials

Objects with different material properties.

- Opaque/Transparent.
- Emissive.



Transparent



Emissive

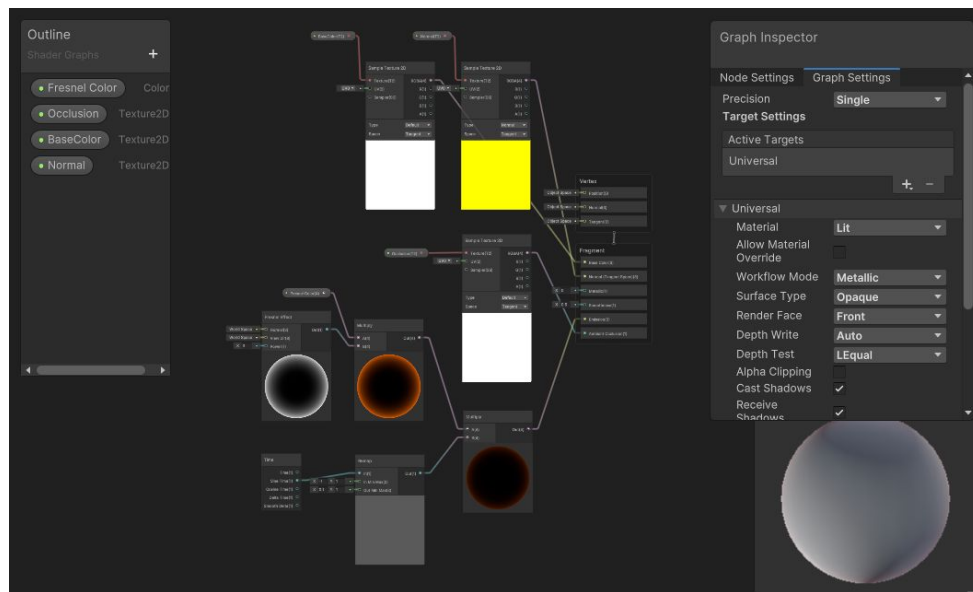
Computer Graphics Topics

Course

05

Shaders

Created custom shaders with **Unity's Shader Graph**, a visual and node-based approach to designing shaders.



Computer Graphics Topics

Course

05.1

Selection Shader

- **Fresnel Effect Node** to define Emission.
- Animate Fresnel Effect overtime with **Time Node**.



Computer Graphics Topics

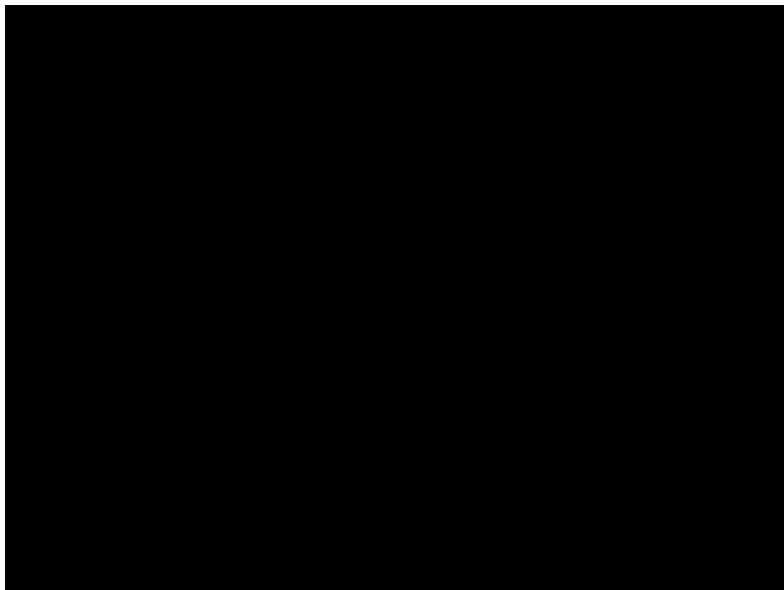
Course

05.2

Water Shader

- Water textures with different offsets over **Time**.

By moving in opposite directions, it creates the illusion of waves.



Computer Graphics Topics

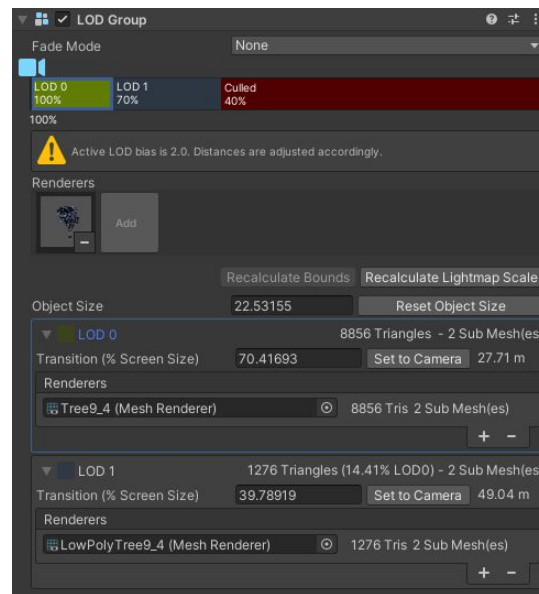
Course

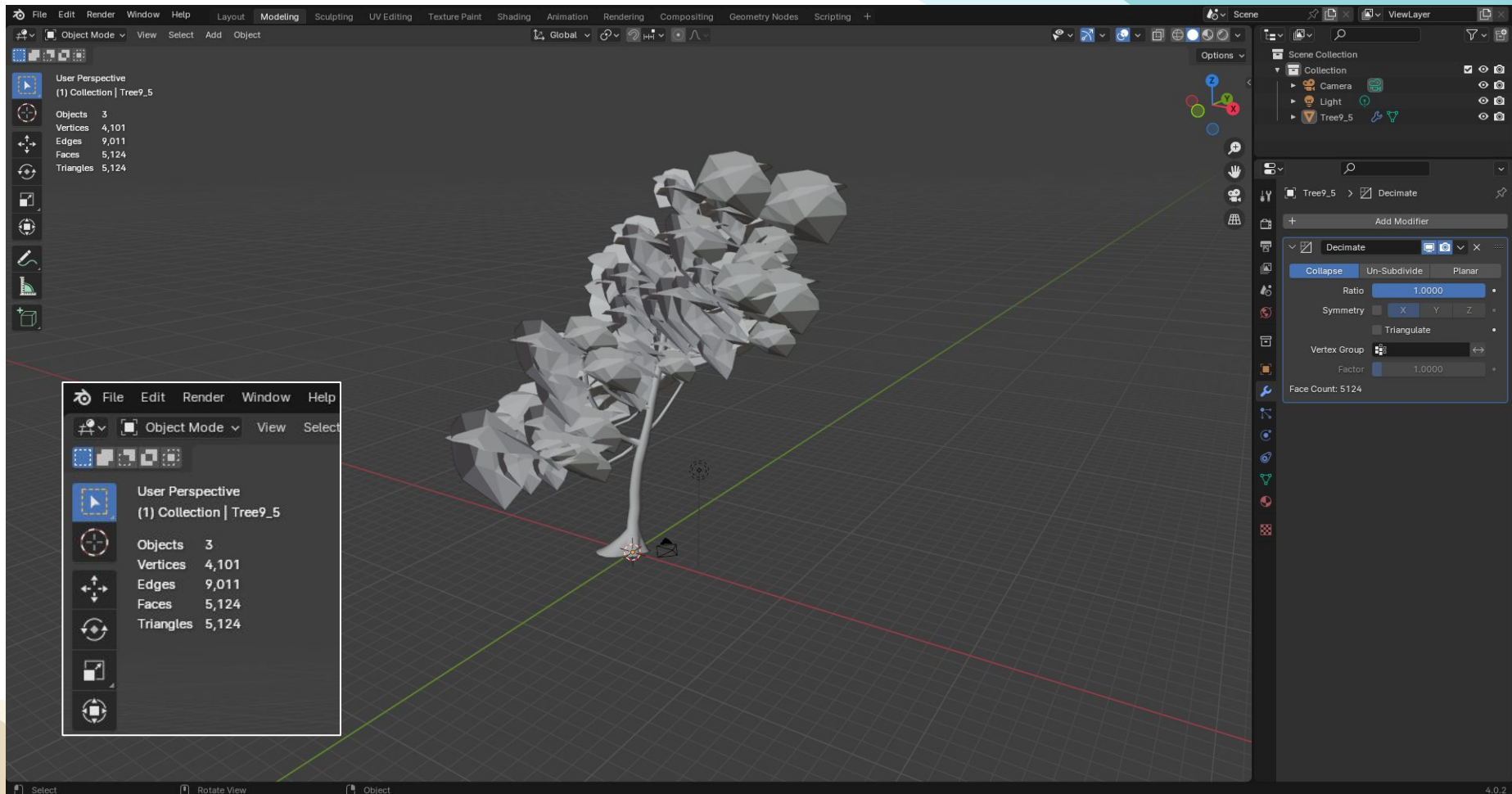
06

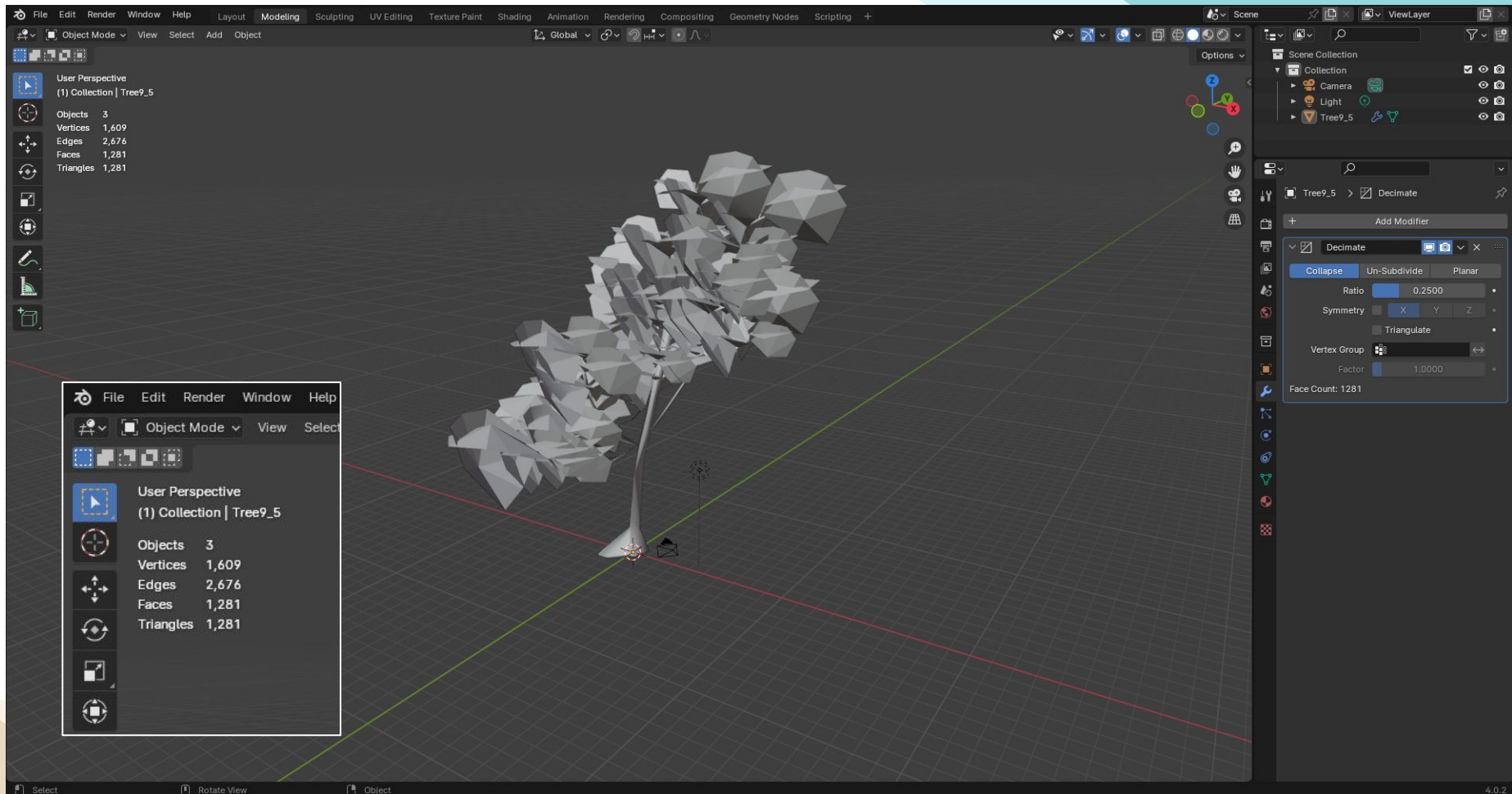
Geometric Modelling

Unity: Level of Detail Groups.

Blender: Applied Decimate Modifier to reduce the vertex/face count of a mesh with minimal shape changes.







Computer Graphics Topics

Course

07

Texture Mapping

Apply textures for more realistic and detailed surfaces.

- Normal Mapping.



Computer Graphics Topics

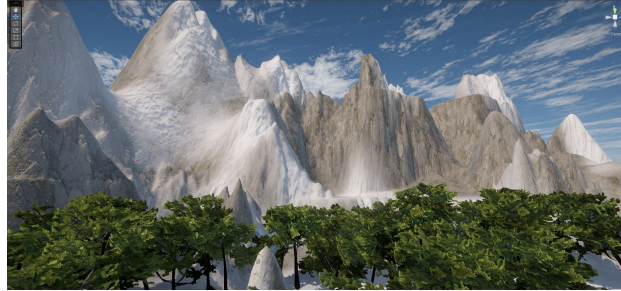
Advanced

08

World Building

World building with:

- Built-in Terrain Tools.
- ProBuilder Package.



Terrain Tools



ProBuilder

Computer Graphics Topics

Advanced

09

Shadow Mapping with Interactable Shadows

For the shadow puzzles, we implemented **interactable shadows**.

To achieve this, we have developed a technique to **associate a collider** with the shadow cast by an object.



Inspiration

- [Interactive Shadows in Unity](#)
- [\[TUTORIAL\] Interactive Shadows in Unity](#)

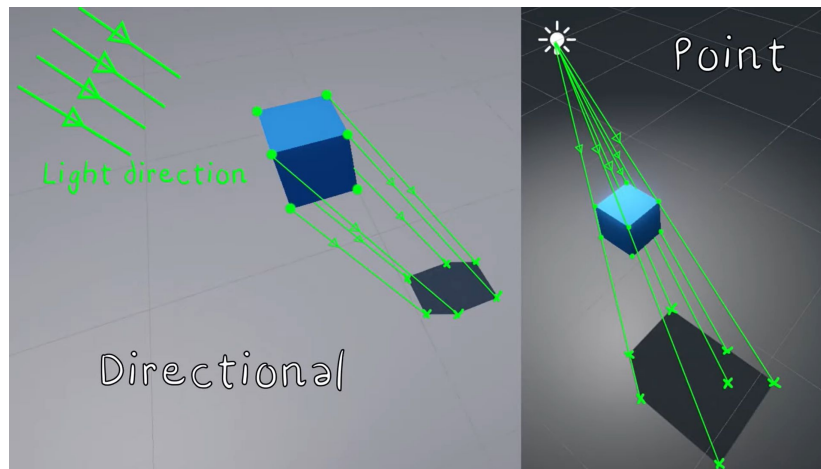
Computer Graphics Topics

Advanced

Casting Rays from Light Source

When an object is illuminated, we **cast rays from the light source** to every vertex of the object's mesh.

These rays represent the paths light would take from the light source to the object's surface.



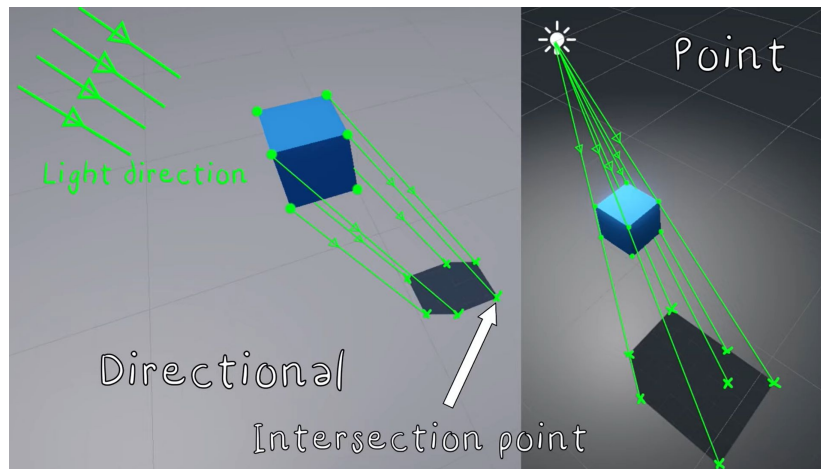
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Advanced

Intersection with Surface

As these rays traverse the game world, they eventually **intersect with the receiving surface** where the object's shadow is projected.

The intersection points on the surface are identified and recorded.



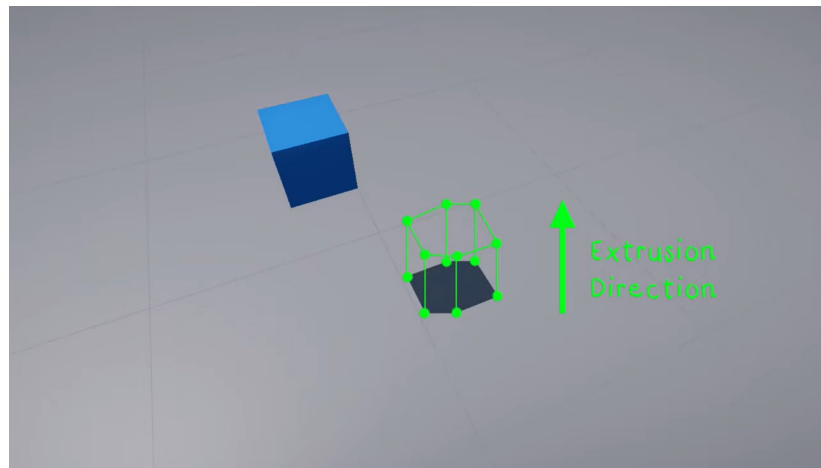
Computer Graphics Topics

Advanced

Extruding Intersection Points

Once we have the intersection points, we use them to create a collider associated with the shadow.

The extrusion process **involves extending the points into the 3D space** to create a collider shape.



Computer Graphics Topics

Advanced



Computer Graphics Topics

Advanced

10

Particle System

Created realistic fire effects with Unity's Particle System.



Computer Graphics Topics

Advanced

11

Post Processing

Implemented Post Processing Effect, such as:

- Tonemapping.
- Bloom.
- Vignette.



Post Processing Off



Post Processing On

Demo



Critical Analysis

We set out to achieve specific objectives that centered around **implementing interactive shadows** and applying them in **puzzle-solving scenarios**.

We successfully met all of our objectives:

- Implemented interactable shadows by associating colliders with shadows.
- Applied interactable shadows in puzzles with paths and platforms.

Challenges

Learning Curve: Blender and Unity can be not beginner-friendly.

Integration Issues: We struggled to integrate Blender-created assets into Unity (i.e., convert from .fbx to .prefab).

Assets Issues: Importing Assets with Built-In Render Pipeline Materials into Universal Render Pipeline.

Critical Analysis

Improvements

Environment Elements: Create environment elements with Unity's Particle System.

- — Realistic fire effects.

Expanding Puzzle Variety: Introduce a series of new shadow puzzles.



Thank you!

Group Self-assessment: 17

