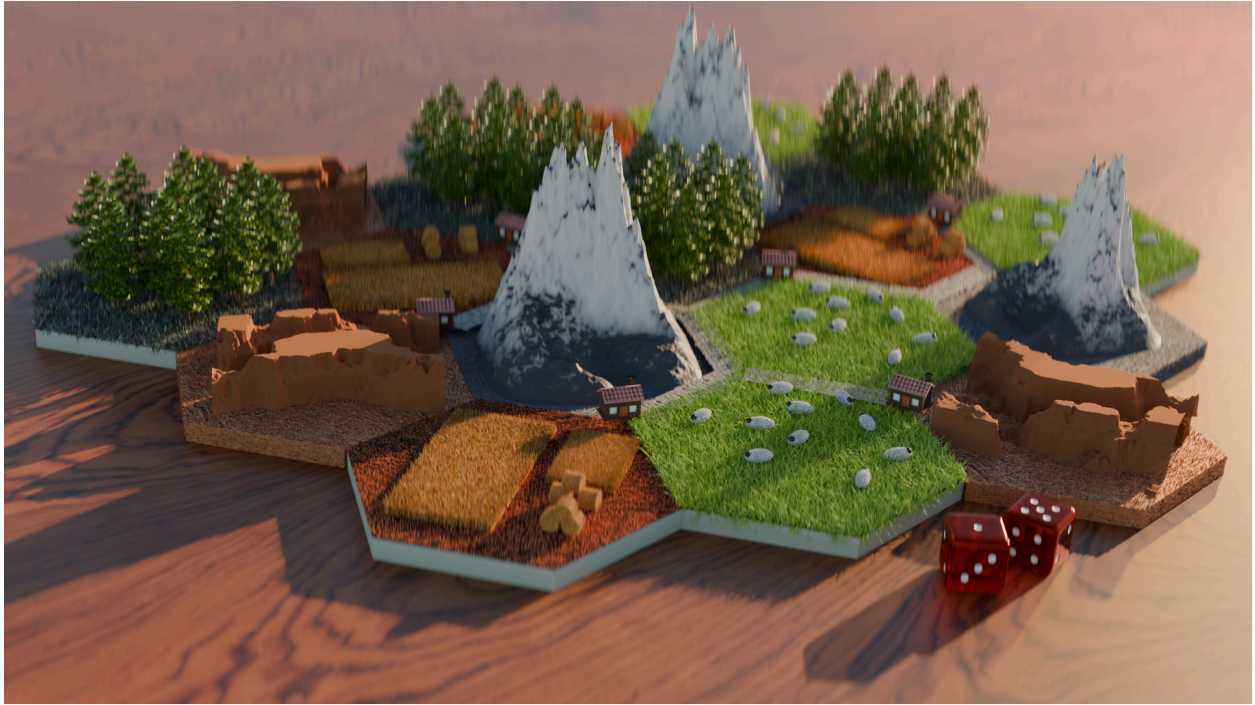


# CS148 Final Project Report: 3D Catan Boardgame

Kenan Ye, Fengyu Li

This project focuses on creating a 3D Catan board with realistic environment tiles and realistic roads and houses.



## Requirements

### Leveraging Ray Tracing for Realistic Lighting

For this project, we utilized the power of ray tracing within Blender Cycles to create a photorealistic and visually engaging 3D rendition of the Catan board game. The scene is illuminated with a **Natasha Sky HDRI** to provide a natural light environment that enhances reflections and shadows. Additionally, we employed realistic lighting techniques such as area lights to soften shadows and add depth.

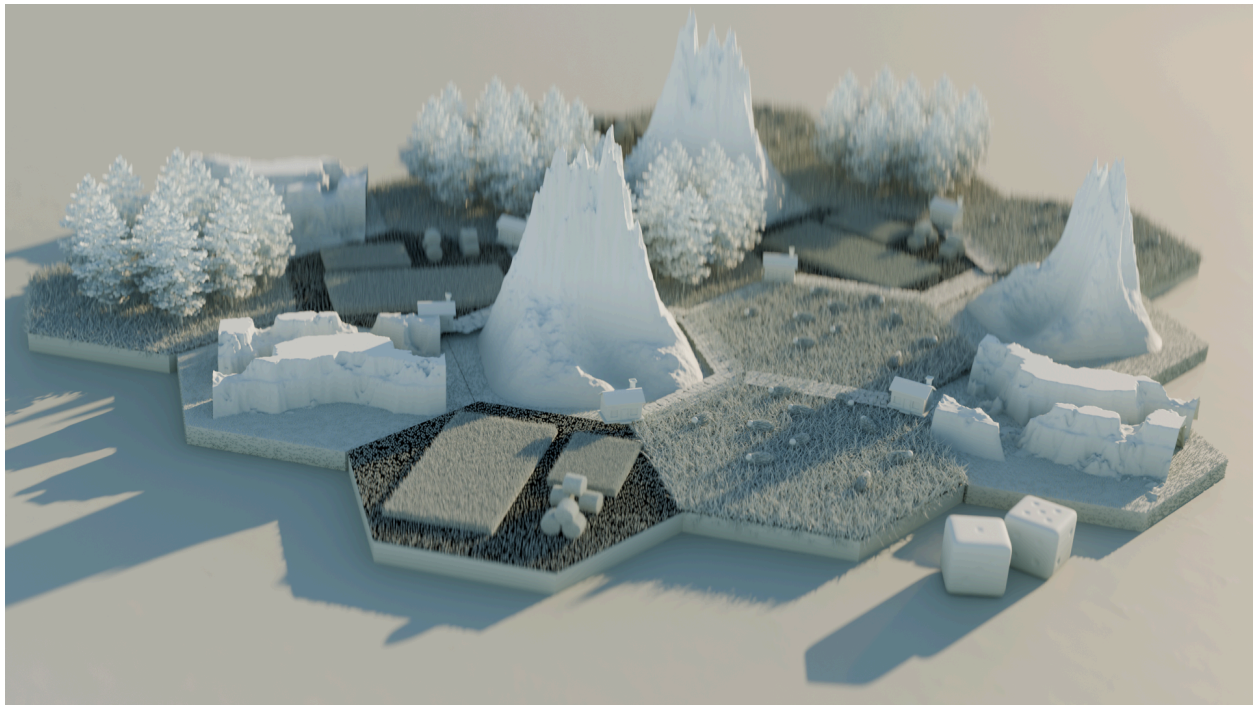
The effectiveness of ray tracing is particularly evident in the **red glass dice**, which showcase realistic light transmission and subtle reflections. The translucent material interacts beautifully with the surrounding light, creating a dynamic and lifelike appearance. The use of ray-traced reflections on the houses, roads, and tiles ensures that all assets contribute cohesively to the overall realism of the scene.

### Geometry Creation

A significant portion of the geometry in this project was modeled from scratch to meet the requirements. I designed the following objects:

- **Sheep, houses, roads, wheat, grass, and dice:** These were meticulously crafted using Blender's modeling tools to capture the essence of the Catan board game.
- **Landscape elements (mountains, canyons, and trees):** These were imported from two libraries, specifically Landscape and Tree Gen, and seamlessly integrated into the scene to provide a detailed backdrop.

The combination of custom-made and imported geometry ensures that the focus remains on the original assets while complementing them with a realistic environment.



## UV Mapping and Texturing

UV mapping was a critical aspect of this project to achieve realistic textures for the objects. While we utilized an online UV map as a base for the **house textures**, I manually adjusted the mapping to ensure proper alignment and realism. We hand-painted or procedurally generated textures using Blender's material nodes for other objects like sheep, wheat, and tiles. This allowed me to give each object a distinct and authentic appearance, enhancing the immersive quality of the scene.

## Advanced Feature: Depth of Field

To enhance the scene further, we utilized the **depth of field** feature in Blender Cycles. This technique simulates the player's vision, focusing on specific tiles while subtly blurring the surrounding areas. This approach adds an immersive quality, making the viewer feel as though

they are actively engaging with the board game. The focused tiles draw attention to the details of the gameplay, while the blurred elements contribute to the realism of the scene.

## Citation of Sources

We have meticulously cited all the resources used in this project to ensure proper acknowledgment. Detailed citations for each asset and resource are in the accompanying project report.

## Contribution

Kenan Ye implemented the house, brick tile, sheep tile, forest tile, wheat tile, and road from scratch for both geometry and texture.

Fengyu Li implemented the mountain tile, brick tile, and dice from scratch for both geometry and texture.

Both collaborated to adjust the camera and lighting to get the scene and write the report.

## Assets

### 1. Forest Hex Tile

- **3D Shape Creation:**  
A hexagonal base with a particle system is used to distribute imported tree models from a library. The trees are randomly placed with varying sizes and rotations to achieve a natural, organic arrangement. [The tree models were imported from an external library and integrated with custom materials.](#)
- **Material:**  
Dark [brown bark](#) and deep [green foliage](#). Using Principle BSDF to make the bark uses a procedural noise texture to create natural imperfections, while the foliage employs subsurface scattering to simulate realistic light penetration.

### 2. Canyon (Brick) Hex Tile

- **3D Shape Creation:**  
A hexagonal base featuring a central depression, sculpted to resemble a canyon with an oil well in the middle. Subdivision surface modifiers are used for smooth transitions in the terrain. [The canyon landscape geometry was imported from a library, but all texturing and material setups were custom-created.](#)
- **Material:**  
Sandy terrain with a [clay surface](#). Using the principle BSDF and Bump map enhances the sand texture's realism.

### 3. Pasture (Sheep) Hex Tile

- **3D Shape Creation:**

A hexagonal base populated with scattered small sheep models, distributed using Blender's particle system. The particle system allows for random placement with variations in scale and rotation to create a natural-looking arrangement. The sheep models were created from scratch.

- **Material:**

Vibrant [green grass](#) and matte wool for the sheep. Using the principle BSDF makes the grass uses a noise texture, while the wool employs a particle system to achieve a soft, matte finish.

#### 4. Mountain Hex Tile

- **3D Shape Creation:**

[A hexagonal base featuring](#) a sculpted mountain with rugged peaks. Dynamic topology sculpting was applied to create sharp, uneven edges and natural rocky details. [The mountain geometry was imported from a library, while texturing and material creation were completed from scratch.](#)

- **Material:**

Gray, rough stone with a [procedural rock texture](#). Using the principle BSDF to make a high-roughness map and with bump mapping highlight the mountain's snow surface details.

#### 5. Wheat Field Hex Tile

- **3D Shape Creation:**

A hexagonal base populated with scattered wheat stalks, distributed using particle system. The particle system allows for natural density, variation, and rotation to replicate a realistic wheat field. The wheat stalks were modeled from scratch.

- **Material:**

[Sunlit yellow wheat](#) and a [dry soil base](#). Using the principle BSDF to make subsurface scattering on the wheat captures sunlight penetration, while a noise texture on the soil adds texture variation and realism.

#### 6. Glass Dice

- **3D Shape Creation:**

Modeled as rounded cubes with indented pips. The bevel modifier smooths the edges, and the boolean modifier is used to create precise indentations for the pips.

- **Material:**

Clear glass with a high Index of Refraction (IOR) for realistic light behavior. Principle BSDF and the glass BSDF shader capture both reflection and refraction to achieve an authentic appearance.

#### 7. Road Model

- **3D Shape Creation:**  
A rectangular rock piece with beveled edges. The solidify, subdivision, and sharpen configurations and randomness transformation to create the rock path.
- **Material:**  
Textured [rock](#). The procedural rock grain texture adds visual depth, and roughness is applied for a slight effect.

## 8. House Model

- **3D Shape Creation:**  
A simple rectangular house with a triangular roof, modeled from scratch. [Following the instructions from YouTube.](#)
- **Material:**  
Using the [house UV map from online](#). The main texture uses the principle BSDF.