

# CS 148 Final Project Report

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## 1 Project Overview



Figure 1: Reference photo



Figure 2: Final image



Figure 3: Variant A



Figure 4: Variant B

Our goal is to create a realistic rendering of a lounge scene located within the Gates Computer Science Building. The scene will include detailed modeling of furniture and interior elements, as well as realistic textures, lighting, and reflections.

## 2 Project Requirements

### 2.1 Leveraging the Power of Ray Tracing

The scene is rendered using Cycles, with various light sources applied to enhance the realism and atmosphere.

- **Ceiling Light:** Produced by adding an emit shader to a cylinder, mimicking an LED light. This ceiling light contributes to most of the scene's brightness and shadows.
- **Light Strips:** These lights surround the lobby above the offices and are created using spotlights directed towards the ceiling, with the light reflecting back into the lobby. These lights have a warmer color, adding variety to the scene's lighting.
- **Sun:** A sun is used to simulate natural light coming through the windows across from the whiteboard.
- **HDRI:** An HDRI of a studio environment is used to complement the lighting, providing an indoor ambiance.

Together, these lights create several effects:

- **Reflection:** Furniture in the lobby is reflected on the office glass panels. Additionally, the red couch and lights are reflected on the whiteboard.
- **Color Bleeding:** There is subtle color bleeding from the red couch onto the ceiling, as well as from the red couch and the orange carpet onto the walls (although these effects are not very pronounced). The metal table stands in the lobby also reflect light.
- **Transmission:** Objects inside the offices, such as posters, are visible through the glass due to the transmission effect.

## 2.2 Main Geometry from Scratch

The vast majority of objects in the scene are modeled from scratch, including all the main objects in the scene.

- **Chair:** The chair stand is made from two cubes (forming the cross below the seat) and four cylinders as the legs. The seat is created from one cube, using a combination of loop cuts, extrusion, and beveled edges to shape it. The seat is then duplicated and rescaled to create the thickness and layering that match the real object.
- **Couch:** Each couch is created from two cylinders, with loop cuts and extrusion used to adjust the shape. As shown in the figure below, we first created the basic form through careful vertex manipulation in symmetry mode. The process involved making loop cuts around the cylinders and using proportional editing (Ctrl+G with X/Y/Z constraints) with the butterfly tool to ensure symmetric movements. The final smooth form was achieved by applying smoothing modifiers to this base mesh.

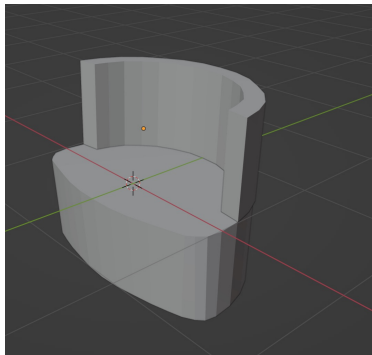


Figure 5: Couch geometry before applying smoothing modifier, showing the underlying vertex structure

- **Walls, Ceilings, Doors, and Glass:** Thick walls are modeled using cubes, while thin walls and the ceiling are made from planes. For walls with glass panels and office doors, loop cuts are applied to the planes, and different textures are assigned to the subdivisions to differentiate them.
- **Skirtboard:** This is the brownish strip at the bottom of the wall. It is modeled with planes, and made into curved shape with a subdivision modifier. The corner is made sharper using loop cut to fit closely with the wall.
- **Door Handle:** The door handle is modeled using two cubes, with loop cuts and manual vertex adjustments.
- **Carpet:** The floor carpet is represented by one plane, with each orange patch on the carpet modeled as a separate plane.

- **Light Strip:** The light strip above the offices is modeled using a stretched cube, with six spotlights placed on top of it.
- **Ceiling Lights:** The recessed lights in the ceiling are modeled using surf cylinders (with thickness adjusted via a solidify modifier), with an emitting cylinder placed at the center.
- **Office Tables:** Each office contains a wooden table, modeled from a single cube.
- **Lobby Tables:** The round tables in the lobby are modeled using an extruded circle for the tabletop, a cylinder for the table stand, and cubes plus cylinders for the legs. The coffee table (the lower table next to the couches) is modeled in the same way but with different dimensions.
- **Posters and Paper:** Posters and papers hanging in the office are modeled as planes.
- **Whiteboard:** Each of the four whiteboards in the lobby is modeled using an extruded plane.
- **Marker Holder:** The marker holder, as shown in the figure, is constructed from three intersecting planes with cylindrical cutouts. The structure was created by using boolean difference operations between the planes and multiple cylinders to create the holes for holding markers. This geometric approach ensures a clean, functional design that matches the practical use of the holder in the reference scene.

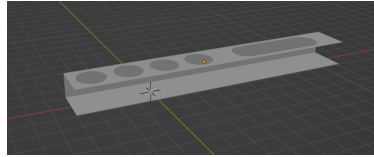


Figure 6: Marker Holder

## 2.3 UV Mapping and Texturing from Scratch

We added detailed texture for each object in the scene, and used geometry nodes to add details.

- **Couch:** We added both material and geometry nodes to create the fuzzy texture, shown as follows.

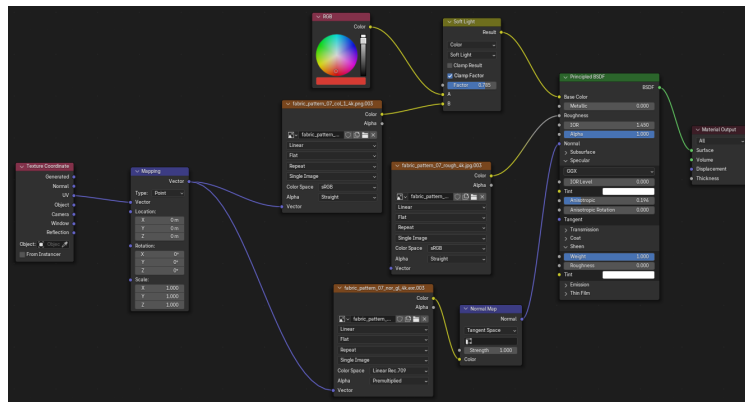


Figure 7: Reference photo



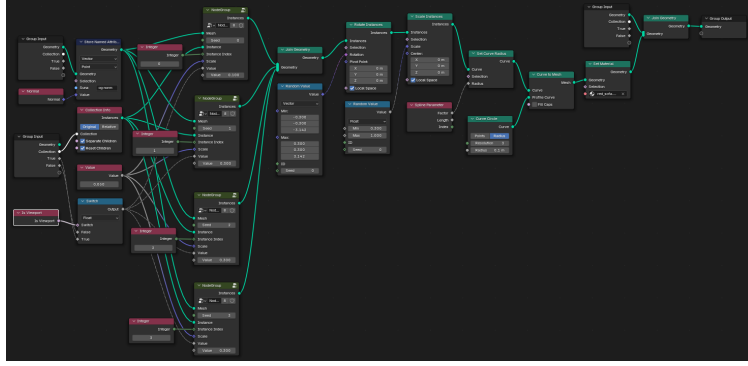


Figure 8: Reference photo

- **Chair:** We reused the geometry nodes from the couch and applied grey fabric texture material.

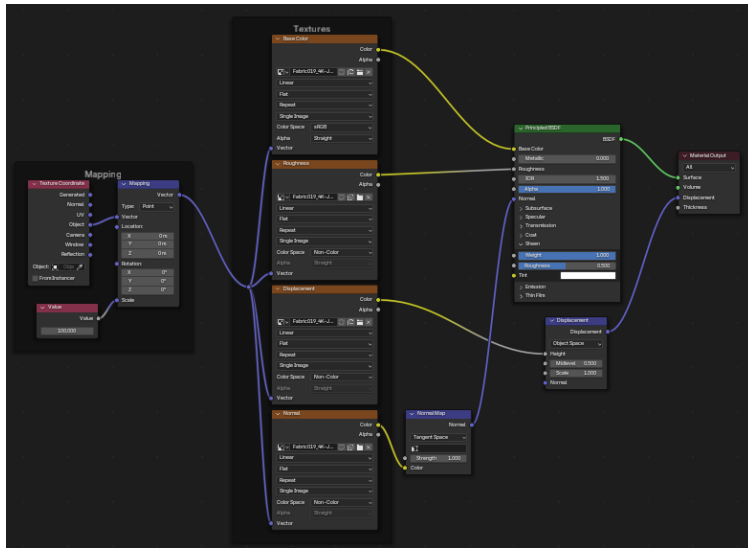


Figure 9: Reference photo

- **Whiteboard:** Whiteboard texture is created via a combination of principled and glass BSDF to model a realistic reflection. The writings on the whiteboard are hand-painted on an iPad, and a different image is made for each of the four whiteboards.

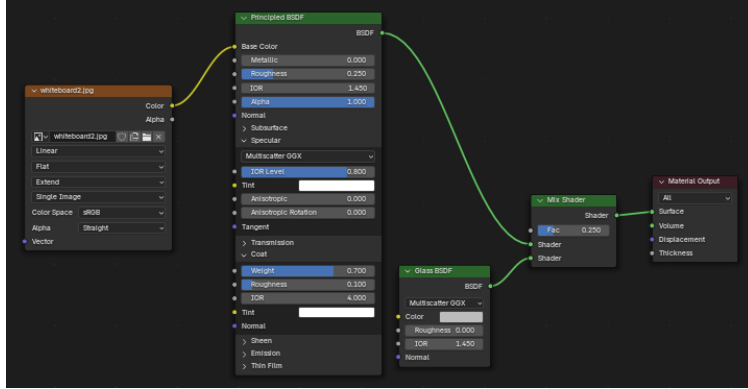


Figure 10: Reference photo

- **Carpet:** We used a carpet texture but replaced the color image with one that more closely matches the pattern. We also mixed the color with a light yellow soft light to make the color resemble the actual. The orange patches on the carpet are modeled as separate planes with the same texture, except mixed with a different color.

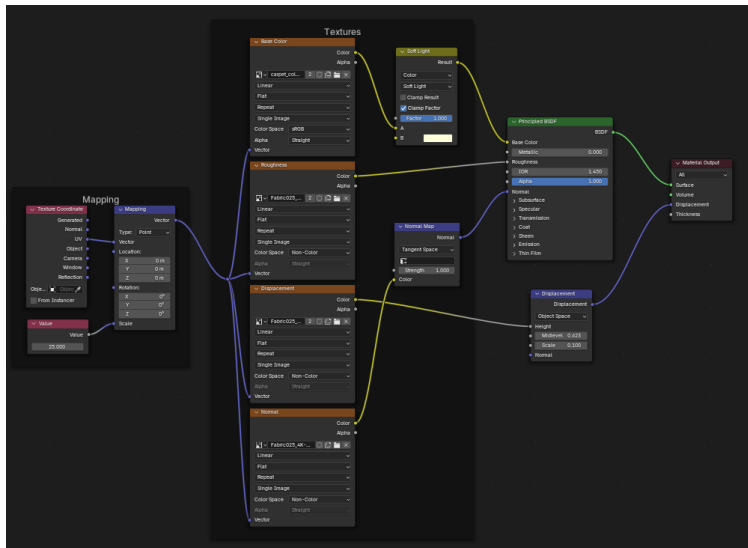


Figure 11: Reference photo

- **Ceiling:** The texture for ceiling is a combination of two different textures from online resources. The color and roughness are from a plaster texture, and the displacement and normal are from a tile texture.

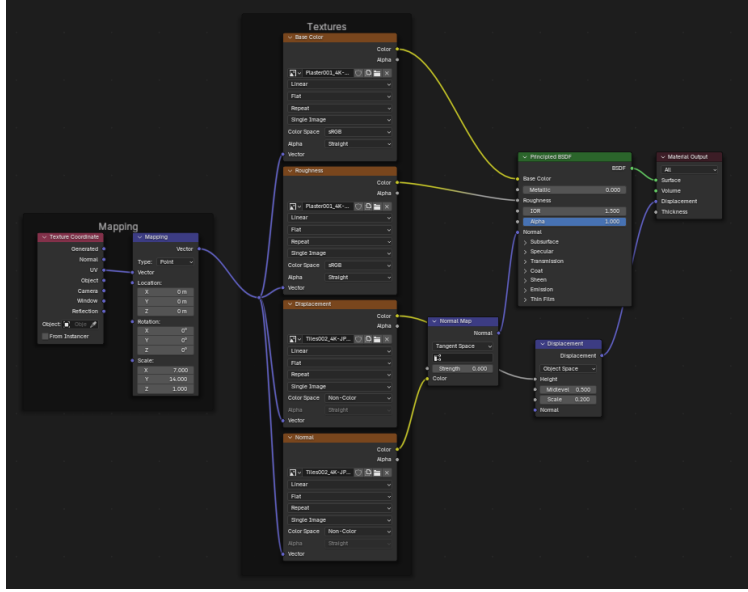


Figure 12: Reference photo

- **Ceiling lights, tables, chair stand, skirtboard, walls, glasses, marker holder:** these are made from a mixture of BSDFs in Blender, with adjusted roughness, specularity, coat to simulate different materials.

## 2.4 Blender/Cycles Advanced Features

We used depth of field as our advanced feature. The focus is set to the table on left, and it can be seen from the image that the farther end of the whiteboard as well as the office doors are blurred because they are farther away from the focal point.

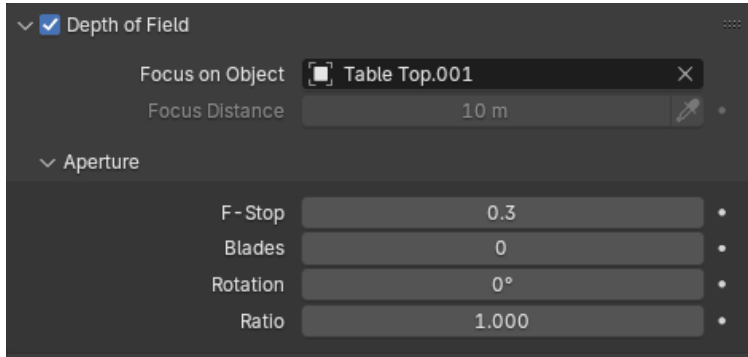


Figure 13: Depth of field configuration

## 3 Group Contributions

- **Yunong:** Created the initial scene setup before attending the NeurIPS conference, including:
  - Modeling the core geometry (couches, walls, door handles)
  - Setting up basic lighting and camera angles
  - Implementing initial materials and textures

- Establishing the overall scene layout based on the Gates building reference



Figure 14: Initial scene implementation

- **Rachel:** Refined and finalized the scene with:
  - Modeling the tables, chair, whiteboard
  - Fine-tuning materials and textures for enhanced realism
  - Geometry nodes for couches and chairs to create fuzzy effect
  - Optimizing lighting setup for better ray tracing effects
  - Implementing depth of field and other advanced features
  - Final rendering and post-processing adjustments
  - Scene polishing and detail work

## 4 Assets

- **Imported Models:**
  - Personal Computer model (barely visible inside the offices) from Sketchfab (<https://sketchfab.com/3d-models/personal-computer-aa398650fe6e4baa8771c71266d842f4>)
  - Bookshelf base model from Sketchfab (<https://sketchfab.com/3d-models/bookshelf-01-0776e98174764ebabc34946b0b526bce>) with custom materials created by our team
  - Macbook (<https://www.cgtrader.com/free-3d-models/electronics/computer/apple-laptop>)
- **Textures:**
  - Carpet texture from The Floor Box and AmbientCG (color: <https://thefloorbox.ca/products/carpet-planks-dedication-limestone-13-x-39/b584a6f0-fc19-11ee-87fb-f6968cef729a>, displacement: <https://ambientcg.com/view?id=Fabric025>)
  - Sofa fabric texture from Poly Haven ([https://polyhaven.com/a/fabric-pattern\\_07](https://polyhaven.com/a/fabric-pattern_07))
  - Chair fabric texture from AmbientCG (<https://ambientcg.com/view?id=Fabric019>)
  - Ceiling texture from AmbientCG (tiles: <https://ambientcg.com/view?id=Tiles002>, plaster: <https://ambientcg.com/view?id=Plaster001>)

## 5 Tutorials

- Blender tutorial: <https://www.blender.org/support/tutorials/>
- Fuzz with geometry nodes: <https://www.youtube.com/watch?v=9NM9oaijmLg>
- Applying texture with node wrangler: <https://www.youtube.com/watch?v=XTVWy4IIH3A>