# CS 330 Final Project: Design Decisions

## Overview of the Scene

For my final project, I created a small park environment centered around a wooden bench, a trash can, and a lamp post. My goal was to capture a realistic and peaceful outdoor setting while keeping polygon counts low and maintaining proper lighting and textures. The bench serves as the focal point of the scene, with the trash can to its left and the lamppost to its right

## Object Design and Construction

All objects in the scene were built from basic shapes to meet the low-polygon modeling requirements. The bench was created using a series of box meshes. The seat, backrest, and legs are scaled and positioned boxes that form a realistic representation of a wooden bench. I focused on making sure the proportions felt realistic.  
  
The trash can was made from a cylinder mesh to replicate the shape of a standard metal bin. The can was placed on the plane surface, so it sits naturally on the ground. The lamp post was constructed using a tall cylinder for the pole, a cone for the top cap, and a sphere for the light bulb.

## Textures and Materials

Textures and materials play a major role in achieving realism in this project. The bench uses a high-resolution wood texture applied through texture mapping. This adds grain detail that matches how light interacts with the surface. The trash can and lamppost use a metal texture. I used darker gray tones and subtle specular reflection for the metal to simulate a matte finish. Each object uses material settings for ambient, diffuse, and specular reflection to ensure lighting behaves realistically across all surfaces.

## Lighting Design

I implemented two light sources: one global ambient light and one local point light positioned at the lamp post bulb. The ambient light provides overall scene visibility, while the point light simulates the lamp’s glow, casting light onto the bench and ground plane. The Phong lighting model was used to provide a balance of ambient, diffuse, and specular components. I adjusted the attenuation parameters (constant, linear, and quadratic) to create a realistic falloff from the lamp. The lamp bulb itself emits a warm color with high specular highlights to simulate a glowing light source. The combination of these lights provides a realistic contrast between the illuminated bench area and the surrounding shadows.

## Camera Controls and Navigation

I implemented free camera movement that allows users to explore the 3D environment from multiple perspectives. The WASD keys move the camera forward, backward, left, and right, while Q and E allow vertical motion. Mouse movement controls the camera’s pitch and yaw, and the scroll wheel adjusts movement speed. These controls make it possible to view all objects in the scene at various angles and distances. The orbit radius was increased to ensure the camera could capture the full scene, including the tall lamppost and wide ground plane.

## Coding and Best Practices

Throughout development, I followed clean coding and commenting practices to ensure readability and maintainability. Each major section of code is organized into functions such as PrepareScene() and RenderScene(). Variables are clearly named and grouped logically. Transformations use glm::vec3 for scaling, rotation, and translation to maintain consistency. I also used lambda helper functions for reusing repetitive tasks like applying wood textures or setting UV scales. Each object’s setup includes a defined color or texture, transformation, and draw call, ensuring modularity and clear flow.

## Reflection on Development Choices

My goal was to balance simplicity and realism. The scene demonstrates mastery of 3D transformations, texturing, and lighting while keeping polygon counts low and code clean. The bench acts as a strong central object with natural wood tones, while the lamppost and trash can provide context for the environment. The addition of light emanating from the lamp enhances the visual storytelling of a quiet night scene. Each element was intentionally placed and scaled relative to the others to create a realistic scene.