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Project C: Lighting and Materials

Goals: Build on previous projects by introducing lighting and materials to the 3D environment. Create and use multiple VBO boxes and manipulate vertex and fragment shaders to achieve different types of lighting effects.

User Guide: The camera can be moved using the WASD keys. W/S moves the camera forward/backward along the direction the camera is facing. S/D strafe the camera left/right perpendicular to the direction the camera is facing. Note, the “up” vector for the camera is always along +z so the camera will only strafe along the x-y plane. SHIFT will lower the camera along the +z direction while SPACE will increase the camera’s height along +z. Click and drag the mouse to reorient the camera.

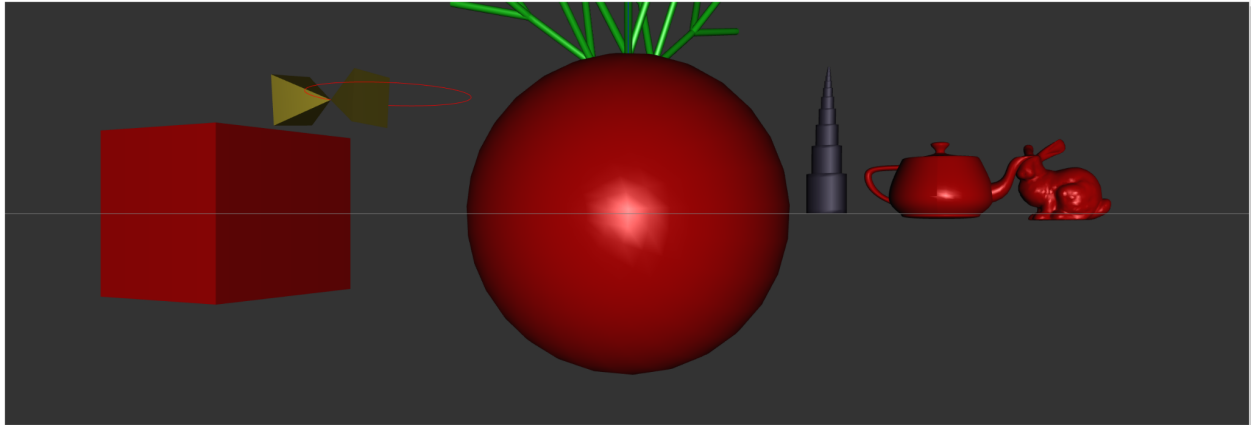
A glass-cylinder approach is used for camera orientation so dragging left and right allows a full 360 rotation in the horizontal plane. However, dragging up/down to look up/down has diminishing effects as you start to approach a vertical orientation.

Animations can be paused/played by pressing P or clicking the Play/Pause button. Note the camera can still be moved while the animations are paused. (Note: as a result, the specular reflections for Blinn-Phong lighting will also move with camera movement while animations are paused).

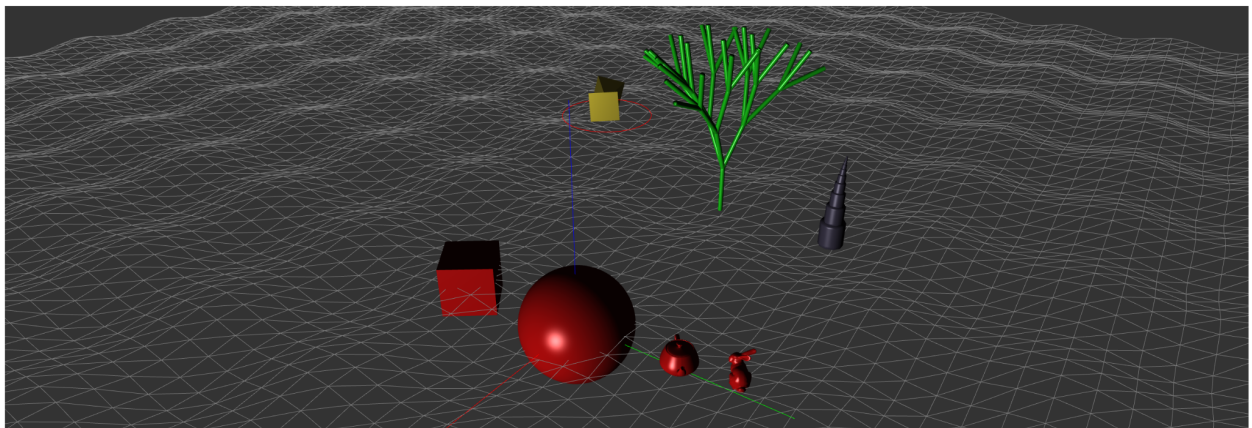
There are three drop-down menus. “Ground Plane Grid Style” allows the user to switch between the “Simple Grid” which is a flat 2D, stationary square grid while the “Triangular Mesh Grid” is an undulating grid that moves using a uniform variable in the vertex shader. “Lighting and Shading Style” allows users to switch between the four combinations of Blinn-Phong/Phong lighting and Gouraud/Phong shading. “Test Objects Material” allows the user to select between 23 different types of materials. This selection changes the material type for the cube, sphere, teapot, and bunny.

Next, there are three color pickers for the Diffuse, Ambient, and Specular light terms that allows the user to change the RGB values of each type of light. Below the color pickers are 3 sliders to adjust the multiplier applied to each type of light. A given type of light can be turned off by setting the corresponding multiplier to 0. Below those are three sliders to move the X, Y, Z position of the World Light. Note: the position of the light is also represented by a small red point in the world. (Move the light around and you can see the location of the light source!)

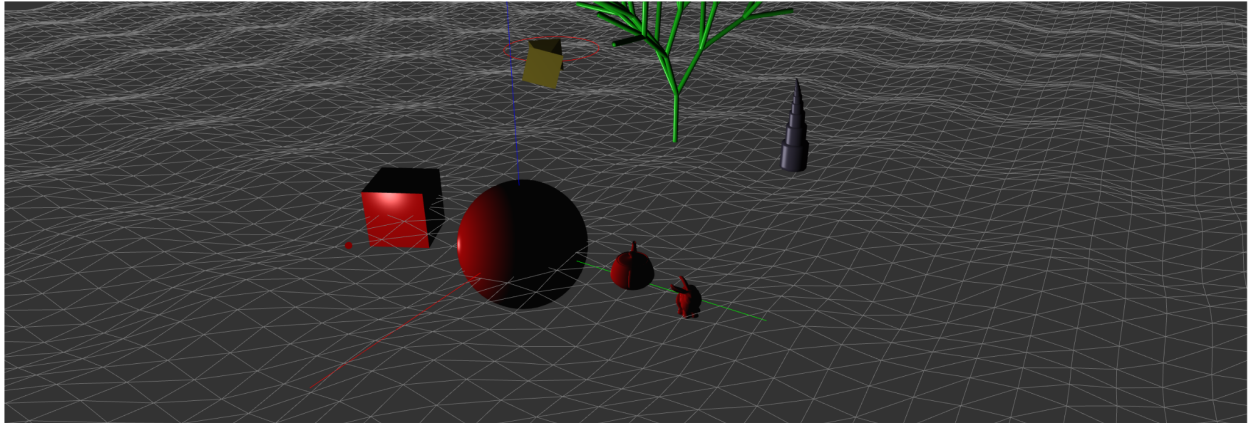
Results: The scene consists of a cube, sphere, teapot, bunny, a set of rotating pyramids, a recursive tree, and a moving tentacle. The cube, sphere, teapot, and bunny all have the same adjustable material while the rest have distinct material types.



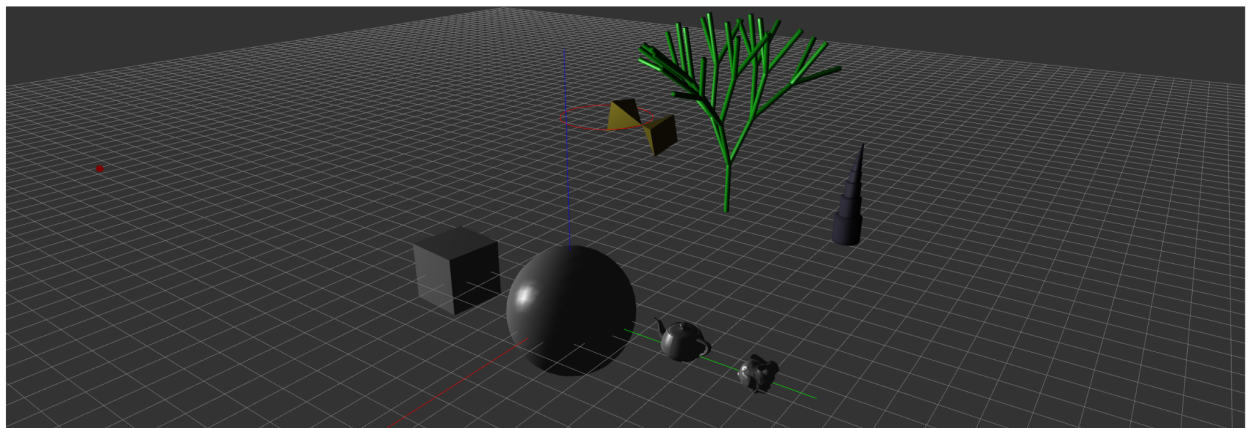
The initial view of the scene. The camera is at $(5, 0, 0)$ looking towards the origin (hence the ground plane looks like a line across the scene). In this image, the objects are being illuminated using Blinn-Phong lighting and Gouraud shading. The 4 objects in the foreground have the same red plastic material while the pyramids are shiny gold, the tree is emerald, and the tentacle is obsidian.



The camera in this image has been repositioned. Here we can see the undulating triangle mesh grid and the world axes drawn on the scene. Note also that the objects are lit using Blinn-Phong lighting and Phong shading which results in the smooth appearance of the specular highlights (seen especially on the sphere and teapot). Note also how with Blinn-Phong lighting, the specular highlight has moved slightly in the direction of the camera compared to where it would be with Phong lighting.



Here we can see the light position moved to a point above the plane between the cube and sphere (look for the small red dot next to the cube that represents the position of the light). This scene is lit using Phong lighting and Phong shading. As a result, the specular highlight is in the direction normal to the surface towards the light. We can also see the per-fragment shading on the cube with the specular highlight.



This scene is using Blinn-Phong lighting and Gouraud shading. We can see the specular highlight closer to the edge of the lit part of the sphere due to the camera's position while using Blinn-Phong lighting and the faceted look of the shading. The material is now "Chrome" for the foreground objects and the ground grid is back to the "Simple" square grid.