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Solar System with Blinn-Phong Point lighting

I have modeled here a solar system, spacecraft, and bouncing spheres in space with a ground plan. All of the objects are made of different phong materials and there are two lights in the world. One light is a moveable light, where the user can determine its position, ambient, diffuse, and specular values and the other is a headlight on the camera. There are many ways the user can interact with this model. The user can adjust the camera positions using the arrow keys and the WASD keys. The left key strafes left, the right key strafes right, the back key moves the camera backwards, and the up key moves the camera forward. The A key rotates the camera left, the D key rotates the camera right, the S key tilts the camera down, and the W key tilts the camera up. After adjusting rotation, all the arrow keys rotate their direction as well so they move in accordance to the rotation. After adjusting the tilt, the up arrow key can dive or climb according to the tilt. The other three arrow keys remain on the same z plane so that navigation is simpler. The user can also adjust the position, ambient value, diffuse value, and specular value of the moveable light by inputting values in their appropriate text boxes and pressing the buttons. The ambient, diffuse, and specular values is recommended to go from 0 to 1. Where 1 is more of the light component and 0 is turning off the light component. The user can also change the position of the light by putting the X, Y, Z values respectively in the three text boxes and pressing the position button.

I started working on this model by first exploring point lighting. Using simply a sphere in world coordinates and its normal vectors, I attempted to write lamp shaders for diffuse and ambient lights that would like the sphere in a specific light direction. After I have succeeded with this, I decided to make the sphere out of a phong material and to add specular lighting. I did this by modifying the shaders from the starter code to work for the sphere in world coordinates and played around with different materials to explore how shine and specular highlights changed the appearance of the sphere. Figure 0 shows a sphere that is lit by point lighting with ambient, diffuse, and specular light. The phong material is a red plastic material.
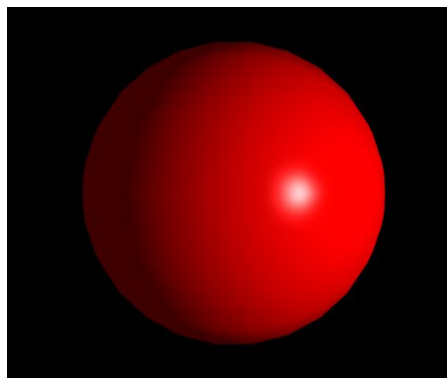

Figure 0: Red plastic phong sphere lit by a point light, consisting of ambient, diffuse, and specular light components.

I next decided to add my solar system from the previous projects into the model. I had to write surface normal vectors for all of my shapes and I then had to use inverse of the modelMatrix and transpose matrix in order to keep the objects lit from the light direction while animated. Figure 1 shows the solar system with a sun planet and a moon with gold, turquoise, and pearl phong materials respectively lit by a point light.
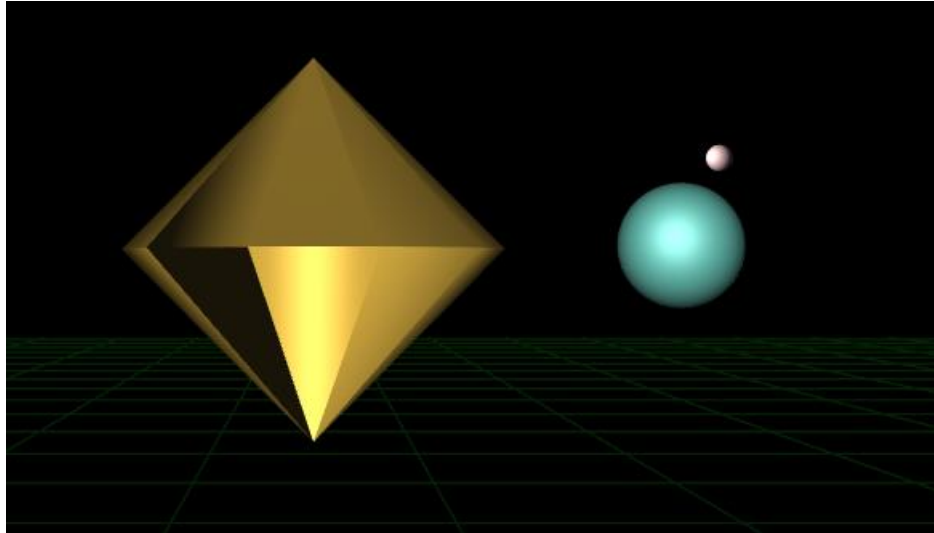

Figure 1: The solar system lit by a point light. The sun is shiny gold, the planet is turquoise, and the moon is pearl.

I then added in my camera controls from the previous project and the window resize function. I then also put in my starship from my previous project. I used push and pop matrices to create the different objects on different areas on the ground plane. I applied the point light and phong materials to the starship as well. Figure 2 shows the lit starship made of brass and blue plastic with a camera view from the camera controls.
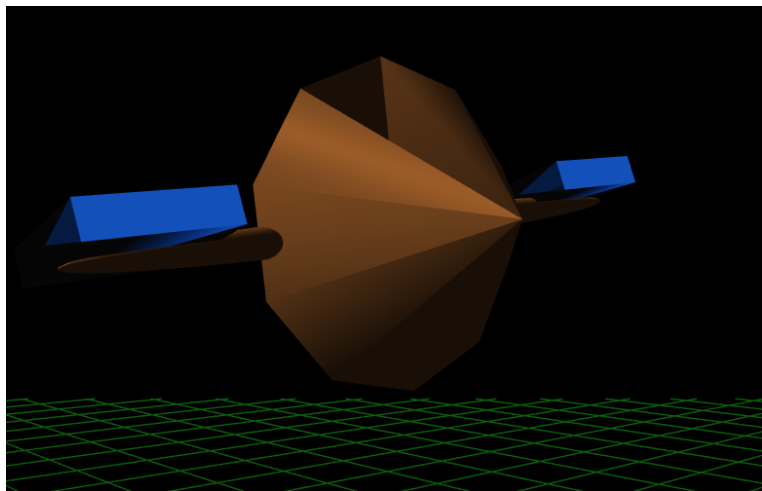

Figure 2: The starship with main part and rod made of brass and blue plastic solar panels. Taken from a camera that rotated, tilted, and climbed.

I added the third object, bouncing spheres in a different area of the ground plane using push and pop matrices. The spheres are all green plastic. I then proceeded to make user controllable buttons and forms to position and change light component values of the moveable lamp. I then added the headlight where the lamp position was the eye position of the camera. Figure 3 shows the model lit by two lamps.
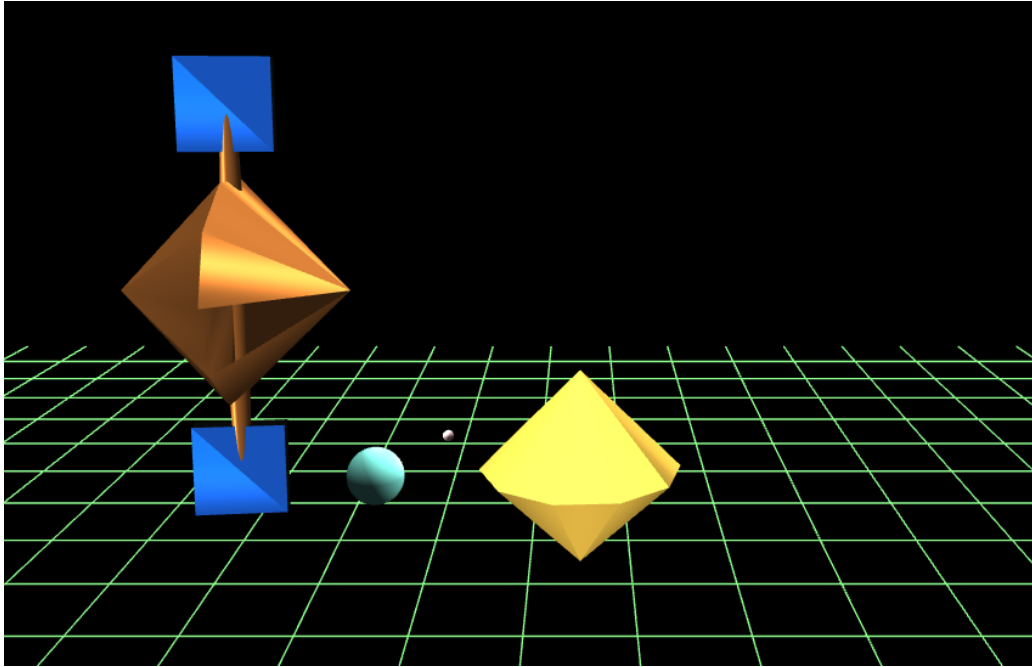
Figure 3: The starship and the solar system lit by a headlight on the camera and a moveable light.

All the objects have different phong materials. Below I have a scene graph with all the nodes as different shapes that come together to form jointed objects through transformations and phong material declarations depicted by the lines below the world. At the top is the canvas which leads to the CVV. The CVV is adjusted by the perspective projection. The next node is the camera which can be adjusted by the view Matrix. The next node is the world with the ground plane, drawing axis, and shapes.

Scene Graph

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                    ┌─────────────────┐
                    │ Canvas          │
                    └─────────────────┘
                            │
                    ┌─────────────────┐
                    │ CVV             │
                    └─────────────────┘
                            │
                    ┌─────────────────┐
                    │ Camera          │
                    └─────────────────┘
                            │
                    ┌─────────────────┐
                    │ World           │
                    └─────────────────┘
         ┌──────────────┬──────┴───────┬──────────────┐

┌──────────────┐  ┌────────┐    ┌──────────┐   ┌────────────┐
│ Ground Plane │  │ Star   │    │ Starship │   │ Big Sphere │
└──────────────┘  └────────┘    └──────────┘   └────────────┘
                      │              │                │
                 ┌────────┐     ┌────────┐      ┌─────────────┐
                 │ Planet │     │ Rod    │      │ Medium      │
                 └────────┘     └────────┘      │ Sphere      │
                      │          │      │       └─────────────┘
                 ┌────────┐  ┌──────────┐ ┌──────────┐  │
                 │ Moon   │  │ Solar    │ │ Solar    │ ┌────────┐
                 └────────┘  │ Panel    │ │ Panel    │ │ Small  │
                             └──────────┘ └──────────┘ │ Sphere │
                                                       └────────┘
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