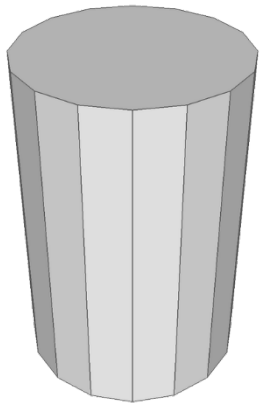
Homework 4 – More Lights and Shapes

For this assignment you will be expanding on your base shape and light options. At this point you have created a Triangle, Square, Cube, Octahedron, and Sphere. You need to add the ability to create each of these shapes for your 3D work, remember each will need normals as well. In addition to these we will add a new 3D shape: Cylinder.

Cylinder

Instead of an octahedron, start with a diamond. Also, instead of sub-dividing triangles we are just going to sub-divide line segments. So each line segment of the diamond just sub-divide it two or three times. That should give you 5 or 9 points on each segment to work with. Then just apply the expansion technique from the sphere to the points and you should get a circle shape. Do that with another diamond and you'll have two circles. Then just join those two "circles" with rectangles and you have a cylinder – see image to the right. Image taken from: OpenGL Cylinder, Prism & Pipe (songho.ca)



Note the youtube video series has a video on one approach to organizing shape information: Vertex Data Structure and Shape Data and Geometries (#31 and #32).

These should allow you to create some fairly interesting 3D scenes. Next up you need to improve on the lighting system. Our system from Homework 3 is just:

Infinite White Light Source: a single source of light that is infinitely far away that is the color white (think something like the sun).
Ambient White Light: a white light that hits everything the same amount at some intensity level.

To make our lights more interesting we want to update the system to allow for the following light options:

Infinite <Color> Light Source: a single source of light that is infinitely far away that is a specified color.
Ambient <Color> Light: a light of a specified color that hits everything the same amount at a specified intensity.
Close <Color> Point Light: This light has a position in the scene and gives off light in all directions of a specified color.
Close <Color> Spotlight: This light has a position in the scene and gives off light in a specific direction and area of a specified color.

Reminder, for lights that are close to get an accurate look at how they affect the shapes we need to move their processing to the fragment shader. This is because the vector to the light changes as you move across the surface of the shape – light that is infinitely far away does not have this. Reminder the book has much of this provided in the lighting chapter, you just need to adapt it to your program.

Lights themselves are not diffuse or specular, that is based on the material of the shape. As such we also need a way to state how diffuse or specular our shapes are. To keep it simple we will assume the

whole shape is made of the same material. So, each shape will have a diffuse strength of 0 to 1 and a specular strength of 0 to 1 that we will pass into the shaders. Keep in mind that usually a shape that has a strong specular strength (very shiny) usually has a low diffuse strength (absorbs the light).

Display

Need at least two of each shape in the scene, each shape being a different color and material (diffuse/specular settings). Each shape should be positioned in a different location in the scene and rotated by some amount. For lights you need one of each type of light, each one a different color. So they don't overwhelm each other the ambient and the infinite lights should not be more than .2 in intensity for any one color. For the point and spot light sources they should not be more than .3 in intensity for any one color.