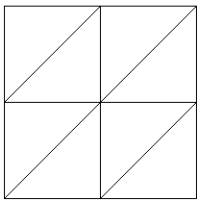
Algorithm Assignment: Shapes

Help Session: Tuesday September 22, 7:00 pm, location TBA
Algo Due: Tuesday, September 22, 5:00pm
Program Due: Friday, September 25, 11:59pm

1 Cube

Run the demo and take a look at one face of the cube. In fact, take a look at one edge of one face in wireframe mode. Change the tesselation parameter. How do the number of small squares against one edge correspond to the tesselation parameter?

You need to tesselate the face with triangles. You know that the edges of the cube span from $-\frac{1}{2}$ to $+\frac{1}{2}$. Let's make the tesselation parameter = 2. Write down the 3D coordinates for the vertices of the eight triangles which are on the plane $z = \frac{1}{2}$. Label them left-to-right in the spaces given.



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What are the normal vectors that correspond with each of these eight triangles? (**Note:** when asked for a normal, you should always give a *normalized* vector, meaning a vector of length one.)

2 Cylinder

The caps of the cylinder are regular polygons with N sides, where N's value is determined by parameter 2. You will notice they are cut up like a pizza with N slices which are isosceles triangles. The vertices of the N-gon lie on a perfect circle. How will you figure out where the vertices lie in terms of the radius (0.5) and the parameter theta? (What is the equation of the circle that they lie on?)

What is the surface normal of an arbitary point along the barrel of the cylinder? It might be easier to think of this problem in cylindrical coordinates, and then transform your answer to cartesian after you have solved it in cylindrical coords.

3 Cone

Look at the cone with Y-axis rotation = 0 degrees, and X-axis rotation = 0 degrees. How many triangles make up one of the $p2$ "sides" of the cone when parameter1 = 1? When $p1 = 2$? 3? n?

What is the surface normal at the tip of the cone? A singularity does not have a normal. You may achieve a good shading effect by thinking of $p2$ vectors with their base at the tip of the cone, each pointing outward, normal from the face of the triangle assocated with it along the side of the cone. This implies that there will not be a unique normal at the tip of the cone. Each of the $p2$ attached triangles will have a normal dependent on its own position in the surface; specifically, the normal for a given triangle at the tip should be normal to the plane defined by that specific triangle. (Think about how GL can use this information to make a realistic point at the top of the cone) Draw a simple schematic sketch illustrating the normal for one of the triangles at the tip. As long as it is clear that you "get the idea", you will recieve full credit.

Take the two dimensional line formed by the points $(0, \frac{1}{2})$ and $(\frac{1}{2}, -\frac{1}{2})$, and find its slope, m.

$m =$

Then, $-\frac{1}{m}$ is the slope perpendicular to this line. Using this, we can find the vertical and radial/horizontal components of the normal on the cone body. The radial/horizontal component is the component in the XZ plane. What is the magnitude of this component in a **normalized** normal vector?

The component in the y direction is the vertical component. What is the magnitude of this component in a normalized normal vector?

4 Sphere

The sphere in the demo is tesselated in the latitude-longitude manner, so the points you want to calculate are straight spherical coordinates. The two parameters can be used as theta and phi, or longitude and latitude. Write the equations to convert theta and phi into cartesian coordinates.

What is the surface normal of the sphere at an arbitrary surface point (x,y,z)?