CIS 441/541: Project #1E
Due October 24th, 2016 (which means 6am October 25th)
Worth 6% of your grade

Instructions
1) Download reader1e.cxx. It extends the previous "GetTriangles" routines by setting the normal at each vertex.
2) Download the geometry file "proj1e_geometry.vtk".
3) NOTE: there are new data members for the Triangle class.
   class Triangle
   {
     public:
        double      X[3];
        double      Y[3];
        double      Z[3];
        double      colors[3][3];
        double      normals[3][3];
   };

   Normals is indexed by the vertex first and the dimension second.
    int vertexId = 0;
    int x = 0, y = 1, z =2;
    normals[vertexId][y] = ...;

4) Download the file shading.cxx. This file defines a data structure that contains the parameters for shading.
5) Extend your reader to do Phong shading. Use two-sided lighting for the diffuse component, but only one-sided lighting for the specular component.
   a. Note: we will do shading as we rasterize, and use a view direction of (0,0,-1). This is at best approximately correct, and we will re-visit this decision in 1F.
6) The correct image is posted to the website

When you are done upload the following to Canvas:
- your code
- a screen shot of the differencer program congratulating you
- if there are differences, send me the differenceMap.png that differencer produces and image output of the program.
   o Note: incorrect images are likely to earn less than half credit. I'd rather have correct submissions late than incorrect submissions on time.

Potentially useful output for triangle 0 follows.

fawcett:proj1E childs$ ./project1E.app/Contents/MacOS/project1E
Reading
Done reading
Doing triangle 0
Doing flat top triangle
(555.556, 878.788, -0.953948)/(0.119826, 0.119826, 0.572887)/(0.243483,0.286742, 0.92655), (548.422, 878.788, -0.949495)/(0.114627, 0.114627, 0.563515)/(0.537369,0.245201, 0.806915), (555.556, 873.333, -0.949495)/(0.113241, 0.113241, 0.561015)/(0.26851,0.640408, 0.71957)
Left = 1
Bottom = 2
SLs = 874-878
For scanline 874, leftRGB = 0.11341, 0.11341, 0.561321, and rightRGB = 0.114047, 0.114047, 0.562468
Normals are left: 0.305301, 0.599704, 0.739694, right: 0.267883, 0.602614, 0.751728
Interpolated to 555 as color = 0.113642, 0.113642, 0.561738
CALCULATE SHADING:
        Normal is 0.291751, 0.60087, 0.744202
        Ka = 0, Kd*LdotN = 0.7*-0.770412 = -0.539289, Ks*pow(RdotV, alpha) = 0*pow(0.346685, 7.5) = 0
Z = -0.949693
For scanline 875, leftRGB = 0.113665, 0.113665, 0.561779, and rightRGB = 0.115254, 0.115254, 0.564644
Normals are left: 0.359819, 0.53314, 0.765697, right: 0.265655, 0.542092, 0.797223
Interpolated to 554 as color = 0.11412, 0.11412, 0.5626
CALCULATE SHADING:
        Normal is 0.333173, 0.53625, 0.77552
        Ka = 0, Kd*LdotN = 0.7*-0.82032 = -0.574224, Ks*pow(RdotV, alpha) = 0*pow(0.472349, 7.5) = 0
Z = -0.949885
Interpolated to 555 as color = 0.114849, 0.114849, 0.563914
CALCULATE SHADING:
        Normal is 0.28992, 0.540321, 0.789936
        Ka = 0, Kd*LdotN = 0.7*-0.805901 = -0.564131, Ks*pow(RdotV, alpha) = 0*pow(0.473221, 7.5) = 0
Z = -0.950509
For scanline 876, leftRGB = 0.113919, 0.113919, 0.562237, and rightRGB = 0.116461, 0.116461, 0.56682
Normals are left: 0.412318, 0.460974, 0.78581, right: 0.261846, 0.477647, 0.838624
Interpolated to 553 as color = 0.114598, 0.114598, 0.563462
CALCULATE SHADING:
        Normal is 0.373036, 0.466607, 0.801949
        Ka = 0, Kd*LdotN = 0.7*-0.865381 = -0.605767, Ks*pow(RdotV, alpha) = 0*pow(0.587983, 7.5) = 0

Z = -0.950077
Interpolated to 554 as color = 0.115327, 0.115327, 0.564776
CALCULATE SHADING:
    Normal is 0.330003, 0.471712, 0.817671
    Ka = 0, Kd*LdotN = 0.7*-0.852139 = -0.596497, Ks*pow(RdotV, alpha) = 0*pow(0.593538, 7.5) = 0
Z = -0.950701
Interpolated to 555 as color = 0.116056, 0.116056, 0.56609
CALCULATE SHADING:
    Normal is 0.286305, 0.475811, 0.831645
    Ka = 0, Kd*LdotN = 0.7*-0.837099 = -0.585969, Ks*pow(RdotV, alpha) = 0*pow(0.592338, 7.5) = 0
Z = -0.951326
For scanline 877, leftRGB = 0.114173, 0.114173, 0.562696, and rightRGB = 0.117668, 0.117668, 0.568996
Normals are left: 0.461414, 0.384871, 0.799357, right: 0.256493, 0.410345, 0.875116
Interpolated to 551 as color = 0.114348, 0.114348, 0.563011
CALCULATE SHADING:
    Normal is 0.451684, 0.38659, 0.804071
    Ka = 0, Kd*LdotN = 0.7*-0.914267 = -0.639987, Ks*pow(RdotV, alpha) = 0*pow(0.670271, 7.5) = 0
Z = -0.949645
Interpolated to 552 as color = 0.115077, 0.115077, 0.564325
CALCULATE SHADING:
    Normal is 0.410339, 0.393285, 0.822769
    Ka = 0, Kd*LdotN = 0.7*-0.904418 = -0.633093, Ks*pow(RdotV, alpha) = 0*pow(0.688255, 7.5) = 0
Z = -0.950269
Interpolated to 553 as color = 0.115805, 0.115805, 0.565638
CALCULATE SHADING:
    Normal is 0.36792, 0.39918, 0.839815
    Ka = 0, Kd*LdotN = 0.7*-0.892604 = -0.624823, Ks*pow(RdotV, alpha) = 0*pow(0.699246, 7.5) = 0
Z = -0.950893
Interpolated to 554 as color = 0.116534, 0.116534, 0.566952
CALCULATE SHADING:
    Normal is 0.324691, 0.40423, 0.855087
    Ka = 0, Kd*LdotN = 0.7*-0.878884 = -0.615219, Ks*pow(RdotV, alpha) = 0*pow(0.703045, 7.5) = 0
Z = -0.951518
Interpolated to 555 as color = 0.117263, 0.117263, 0.568266
CALCULATE SHADING:
    Normal is 0.280928, 0.408407, 0.868495
    Ka = 0, Kd*LdotN = 0.7*-0.863353 = -0.604347, Ks*pow(RdotV, alpha) = 0*pow(0.699635, 7.5) = 0

Z = -0.952142

For scanline 878, leftRGB = 0.114427, 0.114427, 0.563154, and rightRGB = 0.118875, 0.118875, 0.571172

Normals are left: 0.50597, 0.306794, 0.806146, right: 0.249712, 0.3414, 0.90614

Interpolated to 550 as color = 0.114826, 0.114826, 0.563873

CALCULATE SHADING:

Normal is 0.484509, 0.310875, 0.817684

Ka = 0, Kd*LdotN = 0.7*-0.944853 = -0.661397, Ks*pow(RdotV, alpha) = 0*pow(0.745183, 7.5) = 0

Z = -0.949837

Interpolated to 551 as color = 0.115555, 0.115555, 0.565187

CALCULATE SHADING:

Normal is 0.44424, 0.317889, 0.837614

Ka = 0, Kd*LdotN = 0.7*-0.936635 = -0.655645, Ks*pow(RdotV, alpha) = 0*pow(0.769078, 7.5) = 0

Z = -0.950461

Interpolated to 552 as color = 0.116284, 0.116284, 0.566501

CALCULATE SHADING:

Normal is 0.402789, 0.324284, 0.855921

Ka = 0, Kd*LdotN = 0.7*-0.92641 = -0.648487, Ks*pow(RdotV, alpha) = 0*pow(0.785868, 7.5) = 0

Z = -0.951085

Interpolated to 553 as color = 0.117012, 0.117012, 0.567814

CALCULATE SHADING:

Normal is 0.360404, 0.330011, 0.872469

Ka = 0, Kd*LdotN = 0.7*-0.914218 = -0.639952, Ks*pow(RdotV, alpha) = 0*pow(0.795252, 7.5) = 0

Z = -0.95171

Interpolated to 554 as color = 0.117741, 0.117741, 0.569128

CALCULATE SHADING:

Normal is 0.317352, 0.335034, 0.887153

Ka = 0, Kd*LdotN = 0.7*-0.900133 = -0.630093, Ks*pow(RdotV, alpha) = 0*pow(0.797111, 7.5) = 0

Z = -0.952334

Interpolated to 555 as color = 0.11847, 0.11847, 0.570442

CALCULATE SHADING:

Normal is 0.27391, 0.339331, 0.899904

Ka = 0, Kd*LdotN = 0.7*-0.884269 = -0.618989, Ks*pow(RdotV, alpha) = 0*pow(0.791516, 7.5) = 0

Z = -0.952958