Homework 3

Due: 1:15 pm, Wednesday, November 9

Note:
1. While discussion on the course material is encouraged, you are required to work on the homework independently.
2. To get the credit, sufficient and appropriate intermediate steps are required in your answers or proofs.
3. Turn in the homework on time. Late homework will not be accepted.
4. Both undergraduate and graduate students must answer the first 4 questions. The graduate students must answer the 5th question.

1. Suppose a triangle consisting of points $P_1 = [0 \ 1 \ 0]^T$, $P_2 = [2 \ 0 \ 0]^T$, and $P_3 = [1 \ 2 \ 3]^T$ measured in the viewer’s frame. Compute the out-facing normal for the triangle.

![Triangle Image]

2. Suppose the viewer is at $[0 \ 0 \ 0]^T$ and all the coordinates are given in the viewer frame. The lighting and material properties are listed as follows
   ```
   light_position( 1.0, 1.0, 1.0, 0.0 );
   light_ambient( 0.1, 0.1, 0.1, 1.0 );
   light_diffuse( 1.0, 1.0, 1.0, 1.0 );
   light_specular( 1.0, 1.0, 1.0, 1.0 );
   material_ambient( 0.5, 0.0, 0.0, 1.0 );
   material_diffuse( 0.5, 0.0, 0.0, 1.0 );
   material_specular( 0.5, 0.0, 0.0, 1.0 );
   material_shininess = 1.0;
   ```

Use the modified Phong Model to compute the RGB values for the three vertices in Problem 1. The distance term can be ignored.

Note: the three lighting components, i.e., ambient, diffuse, and specular, cannot be negative. You need to use max(0, diffuse).

3. Suppose two planar polygons are not on the same plane. Devise a method for testing whether one planar polygon is fully on one side of another planar polygon, i.e., the two polygons are not intersected.

4. Consider the edge of a polygon between vertices at $(x_1, y_1)$ and $(x_2, y_2)$. Derive an efficient algorithm for computing the intersections of all scanlines with this edge. Assume that you are working in window coordinates (discrete).
5. (Graduate students only) Check the solution of Problem 2. Do all three lighting components contribute to the color of the vertex $P_1$? If not, can you move the light such that all three components are positive values? Give an example of such light position.