Week 2 Homework – CMSC405

1. Calculate the plane coefficients (A,B,C and D) of 3 points in a plane defined by P1, P2 and P3, and determine if the point P4 is behind or in front of the polygon surface contained within that plane:

P1 = (10,-20,40);
P2 = (30,3,18);
P3 = (-5,-10,25);
P4 = (-10,12,-19);

Be sure to show your work. Explain why determining if Point P4 is behind or in front of the polygon surface relevant to computer graphics applications.

Calculation:

A= $y_1 (z_2 - z_3) + y_2 (z_3 - z_1) + y_3 (z_1 - z_2)$ = -20(18-25) + 3(25-40) + (-10) (40 - 18)

 = -20*(-7) + 3*(-15) + (-10)*22 = -140 - 45 - 220 = -405

B= $z_1 (x_2 - x_3) + z_2 (x_3 - x_1) + z_3 (x_1 - x_2)$ = 40(30 - (-5)) + 18(-5 - 10) + 25(10-30)

 = 40*35 + 18*(-15) + 25*(-20) = 1400 - 270 - 500 = 630

C= $x_1 (y_2 - y_3) + x_2 (y_3 - y_1) + x_3 (y_1 - y_2)$ = 10(3 - (-10)) + 30(-10 - (-20)) + (-5) (-20 - 3)

 = 10*13 + 30*10 + (-5)*(-23) = 130 + 300 + 115 = 545

D= $-x_1 (y_2 z_3 - y_3 z_2) - x_2 (y_3 z_1 - y_1 z_3) - x_3 (y_1 z_2 - y_2 z_1)$;

 = -10(3*25 - (-10)*18) - 30(-10*40 - (-20)*25) - (-5)(-20*18 - 3*40)

 = -10(75 + 180) - 30(-40 + 500) - (-5)*(-360 - 120) = -10*255 -30*460 - (-5)*(-480)
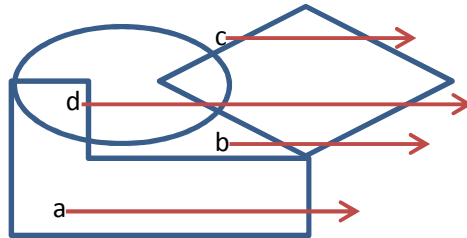
 = -2550 - 13800 - 2400 = -18750

For Point P4:

Ax + By + Cz + D

 = -405*(-10) + 630*12 + 545*(-19) + (-18750)

 = 4050 + 7560 - 10355 - 18750 = -17495

Since -17495<0 P4 is behind the plane.

2. Given the following Shape, use the odd even rule to determine if points a,b,c,d are inside or outside of the object.

Be sure to describe your method and show your "arrows" as needed.

Since point a intersects the object 1 times (an odd number), a is inside of the shape.

Since point b intersects the object 2 times (an even number), b is outside of the shape.

Since point c intersects the object 2 times (an even number), c is outside of the shape.

Since point d intersects the object 1 times (an odd number), d is inside of the shape.

3. Using Visual C++ and your OpenGL configured environment, write an application that displays a "unique" graphical scene that you designed and coded for this course. What you put in your graphical scene is up to you. But it needs to be displayed in a 800 x 600 window and include multiple shapes and include multiple text elements. You need to use Graphic output primitives as discussed in class up till this point. For example, you could create a 2D house with windows, a door and a chimney and label your house "My Dream home". You could also generate a scene with animals, fish, flowers or other objects you want to create based on the primitives. I recommend you use "Graph" paper or a model of some type as your design to make it easier to set your coordinates. Have fun and be creative.

A Christmas tree: