CPSC 314
Assignment 3

Due Monday Nov 2nd, 2015, in class

Answer the questions in the spaces provided on the question sheets. If you run out of space for an answer, use separate pages and staple them to your assignment.

Name: _____

Student Number: _____

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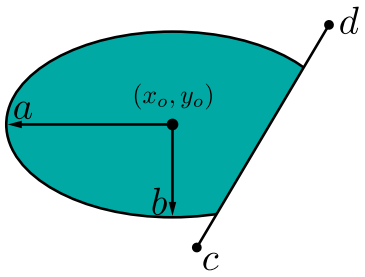
TOTAL	/ 49

1. (5 points) Scan Conversion
   Give the pseudocode for scan converting the region shown to the right.

   It is the portion of the ellipse on the left side of the line defined by fixed points $c = (1, 0)$ and $d = (2, 2)$. The ellipse is centered at (x_o, y_o) with a major axis of length $2a$ and a minor axis of length $2b$. Use implicit equations to develop your solution.



2. (9 points) Interpolation

   A triangle has device coordinates $P_1 = (1, 4)$, $P_2 = (9, 2)$, and $P_3 = (7, 8)$. You wish to interpolate a value v for point $P = (5, 5)$, given the value of v at the vertices:

   $v_1 = 2, v_2 = 8, v_3 = 5$.

   (a) (1 point) Sketch the triangle and the point P.

   (b) (4 points) Develop a plane equation for v as a function of x and y, i.e. $Ax + By + Cv + D = 0$. To do this, determine the constraints based on the given triangle points and their respective values v_i. You can use Matlab or an online linear solver to solve a set of linear equations for your plane parameters. Compute v for point P using the plane equation.

   (c) (4 points) Compute the barycentric coordinates for point P. Compute v for point P using the Barycentric coordinates.

3. (10 points) Clipping
   Suppose that a perspective view-volume is defined by

   `near = -1, far = -5, bottom = -5, top = 5, left = -8, right = 8`.

   Consider the triangle defined by the view coordinate frame coordinates

$$P_1 = (0, 2, -3), \qquad P_2 = (30, -10, -4), \qquad P_3 = (0, 30, -4).$$

   (a) (3 points) Sketch a side-view and top-view of the view-volume and the triangle.

(b) (3 points) Determine if view-frustum culling can be applied to the triangle, i.e., if any vertices are "outside" with respect to any one of the six view frustum planes. Use the implicit plane equation

$$Ax + By + Cz + D = 0$$

Hint: remember what we discussed in class about plane equation and its sign.

Hint 2: If you find you have to do a lot of tedious calculations, think more.

(c) (1 point) Based on your work for the question above, determine the view-frustum planes that the triangle intersects.

(d) (3 points) Compute the final clipped polygon of the triangle in VCS. Show your work.

4. (6 points) Local Illumination

Sketch the illumination for the following scene when computed using the Phong illumination model. The scene is viewed from above using an orthographic projection and is lit by the single light source L. Draw 4 curves (overlay these in the graph below), one for each of ambient, diffuse, specular, and total illumination. The Phong illumination model is given by:

$$I = k_a I_a + k_d I_d (N \cdot L) + k_s I_s (R \cdot V)^n$$

with the following values:

$$I_a = I_d = I_s = 1.0, k_a = 0.3, k_d = 0.7, k_s = 0.9, n = 50$$

Hint: it may be useful to draw vertical lines marking critical points the surface. We do not expect numerically accurate plots, but do expose the characteristics of the curves.