Quiz #2 - CSU540 Computer Graphics - Spring 2005

Professor Futrelle, April 5th 2005 -- Illumination and Bézier Curves

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Put your answers and all your calculations in your Blue Book. You make keep this question sheet. This is a closed-book, closed-notes exam. No calculator is needed or should be used. Draw diagrams carefully and explain the features of them you are trying to illustrate.

Question 1. Bézier curves: Assume that a cubic Bézier curve has the following four control points:

$P_0 = 27,27$; $P_1 = 0,27$; $P_2 = 0,0$; $P_3 = 27,0$

a. Draw the four control points.
b. Draw their convex hull.
c. Draw your approximation of how the curve should look.
d. Calculate the x,y point on the curve corresponding to t=1/3.
e. Show where the point would fall on your curve and discuss why or why it does not appear right. (You might have to redraw your curve to make it a bit more accurate.)

Hint: This calculation can be done entirely with simple fractions and will yield a point with integer coordinates.

Use the cubic Bézier formula for the curve:

$$\mathbf{P}(t) = (1 - t)^3 \mathbf{P}_0 + 3t(1 - t)^2 \mathbf{P}_1 + 3t^2(1 - t) \mathbf{P}_2 + t^3 \mathbf{P}_3$$

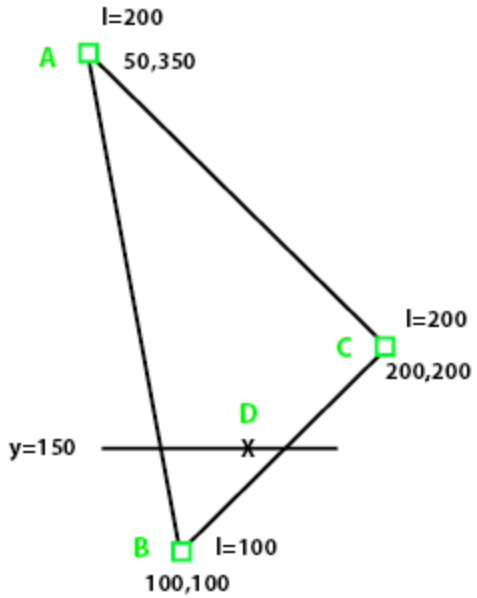
Question 2. Diffuse Illumination:

a. Assume a surface lies in the x,y plane at z=7.
b. Write down the normalized normal vector to the surface, **N**.
c. A light source **L** is in the direction = 3,0,4.
d. Compute the normalized version of **L**.
e. Write down the ambient plus diffuse illumination equation, which I asked you to memorize. Assume, for the red component of the illumination and reflectivity:

   $I_{ambient} = 30$; $k_{ambient} = 0.5$; $I_{point\text{-}source} = 100$; $k_{point\text{-}source} = 0.8$

Using the values above, and the equation, compute the total intensity **I** of the red component of the surface.

Question 3. Gouraud shading: The figure below tells you all you need to know to compute the interpolated intensity at point **D**. The point **D** is 2/3 of the way from the intersection of the scan line with the left edge to its intersection with the right edge. Use this information along with the coordinates of the three vertices and their intensities, **I**, to compute the interpolated intensity.



Extra Credit Question. Computing and averaging surface normals: This is the computation that is done as part of Gouraud shading.

a. Assume that three triangles, attached along their edges, have a common vertex at 0,0,20.
b. Assume that the three points that make up their bases all have z=0 and x,y components 10,10; -10,10; and 0,-10.
c. Compute the three shared edge vectors that meet at the 0,0,20 vertex.
d. Using the three edge vectors, compute the normals to each of the three triangles.
e. Average the three normals to get the average vertex vector, one which could be used, in principle, in a Gouraud shading computation.

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