Quiz #2 (CSE4190.410)

September 29, 2005 (Thursday)

1. (3 points) What are the main differences between computer graphics and image processing.

   In computer graphics, a computer is used to create a picture. Image-processing techniques, on the other hand, are used to improve picture quality, analyze images, or recognize visual patterns for robotics applications. However, image-processing methods are often used in computer graphics, and computer-graphics methods are frequently applied in image processing.

2. (3 points) Explain how the interlacing technique works for slow raster-scan systems. Why is this technique useful for such systems?

   In the first pass, the beam sweeps across every other scan line from top to bottom. After the vertical retrace, the beam then sweeps out the remaining scan lines. Interlacing of the scan lines in this way allows us to see the entire screen displayed in one-half the time it would have taken to sweep across all the lines at once from top to bottom. This technique is primarily used with slower refresh rates. This is an effective technique for avoiding flicker – provided that adjacent scan lines contain similar display information.

3. (3 points) What are the main disadvantages of run-length encoding?

   The disadvantages of encoding runs are that color changes are difficult to record and storage requirements increase as the lengths of the runs decrease. In addition, it is difficult for the display controller to process the raster when many short runs are involved.

4. (10 points) Given a polygon P in the xyz-space, let P_{xy}, P_{yz}, and P_{zx} denote the signed areas of the projections of P onto the xy, yz, and zx-plane, respectively. The signed area of a closed polygon in a plane is positive if the boundary vertices are ordered in a counterclockwise order; otherwise, it is negative. Using these areas, compute the plane equation that contains the polygon P:

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

   and justify your answer.

   Take $A = P_{yz}$, $B = P_{zx}$, $C = P_{xy}$, and $D = -Ax_0 - By_0 - Cz_0$, where (x_0, y_0, z_0) is a vertex of the polygon P.

   We may assume that the polygon P is a triangle with three vertices (x_0, y_0, z_0), (x_1, y_1, z_1), and (x_2, y_2, z_2) ordered counterclockwise. Consider two difference vectors $\mathbf{u} = (x_1 - x_0, y_1 - y_0, z_1 - z_0)$ and $\mathbf{v} = (x_2 - x_0, y_2 - y_0, z_2 - z_0)$, which are parallel to the plane containing P. The vector (A, B, C) is normal to the plane of P, and is parallel to $\mathbf{u} \times \mathbf{v} = 2(P_{yz}, P_{zx}, P_{xy})$

5. (6 points) Consider applying the following food-filling algorithm to the interior of a region starting from a pixel denoted as (1). Show the order of visit to each pixel. How large can the stack grow?

```
void boundaryFill4 (int x, int y, int fillColor, int borderColor)
{
   int interiorColor;

   /* Set current color to fillColor, then perform following oprations. */
   getPixel (x, y, interiorColor);
   if ((interiorColor != borderColor) && (interiorColor != fillColor)) {
      setPixel (x, y);     // Set color of pixel to fillColor.
      boundaryFill4 (x + 1, y , fillColor, borderColor);
      boundaryFill4 (x - 1, y , fillColor, borderColor);
      boundaryFill4 (x , y + 1, fillColor, borderColor);
      boundaryFill4 (x , y - 1, fillColor, borderColor)
   }
}
```