CSE 5392-016 Lab 2

Due March 31

Goals:

1. Understanding of 3-D convex hulls.

2. Understanding of doubly-connected edge lists.

Requirements:

1. Given a file of no more than 1,000 unique points with 16-bit integer coordinates, produce the following:

   a. A DCEL representation that includes only the extreme points, i.e. each face is a convex polygon.

   b. A "triangulated" DCEL representation that includes the extreme points and the points that are on the hull.

   c. For both representations, the number of a face that corresponds to the minimum supporting plane, i.e. the plane whose sum of the perpendicular distances to the original set of points is minimized.

2. Send your program (as an attachment) to `weems@uta.edu` by 5:15 pm on March 31. Please provide details on using your program.

3. In addition to sending your program, have attachments for at least three test cases.

Getting Started:

1. You may work in groups of no more than three students. Be sure to identify each member's contribution.

2. The following computation (`http://mathworld.wolfram.com/TriangleArea.html`) of the area of a 3-D triangle may be useful. The argument to the $\sqrt{}$ is probably all that you might want.

If the triangle is embedded in three-dimensional space with the coordinates of the vertices given by (x_i, y_i, z_i), then

$$\Delta = \frac{1}{2}\sqrt{\begin{vmatrix} y_1 & z_1 & 1 \\ y_2 & z_2 & 1 \\ y_3 & z_3 & 1 \end{vmatrix}^2 + \begin{vmatrix} z_1 & x_1 & 1 \\ z_2 & x_2 & 1 \\ z_3 & x_3 & 1 \end{vmatrix}^2 + \begin{vmatrix} x_1 & y_1 & 1 \\ x_2 & y_2 & 1 \\ x_3 & y_3 & 1 \end{vmatrix}^2}. \quad (17)$$

3. Each DCEL should be output to a file. The first line should be the numbers of vertices (V), faces (F), and half-edges (E). The next V lines should be the vertex coordinates and an incident half-edge # for each. The next F lines should each be a half-edge of that face as a number. The final E lines contain five integers each: tail, twin, face, next edge on face, previous edge on face. Traversing the next edges should be in counterclockwise order facing into the interior. Numberings start at 0, not 1.

   Nothing else should appear in your DCEL files.

4. You may use available hull code as long as 1) appropriate credit is given and 2) the code runs in $O\left(n^2\right)$ time.