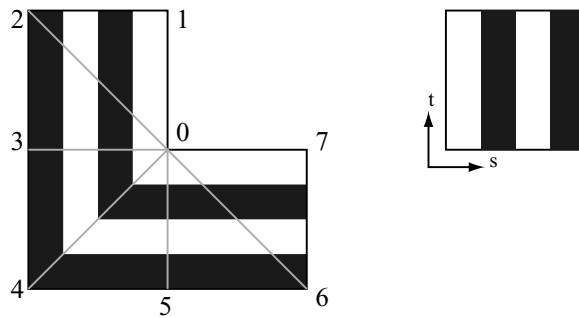# CS 559: Computer Graphics

Homework 6

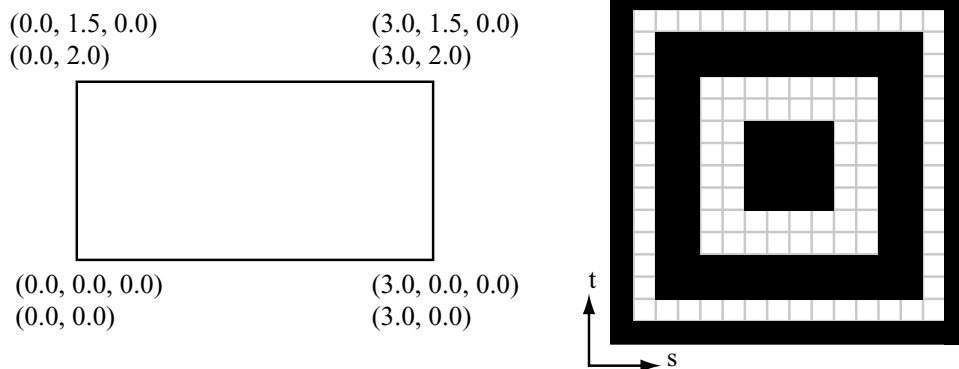*This homework must be done individually. Submission date is Tuesday, November 30, 2004, in class.*

Question 1:

Consider the texture shown below on the right and the textured triangles on the left. The triangles will be drawn as a fan, with vertices given in the order shown. Drawing as a fan, you can only provide one set of texture coordinates for each vertex. The texture is to be repeated in both s and t. Give a set of texture coordinates that could be used for the vertices of the triangle mesh.

Question 2:

On the left is a polygon with both its world coordinates and texture coordinates marked. On the right is a 16×16 texture map that will be used with the polygon.

(0.0, 1.5, 0.0)   (3.0, 1.5, 0.0)
(0.0, 2.0)   (3.0, 2.0)

(0.0, 0.0, 0.0)   (3.0, 0.0, 0.0)
(0.0, 0.0)   (3.0, 0.0)

a. Draw the next mipmap level for the texture. Indicate the intensity of each pixel in each mipmap, and assume the mipmaps are generated by averaging pixels.

b. The polygon is rendered with a perspective view looking toward the negative z axis with the positive y axis pointing up. The viewing and window parameters are such that, for the polygon, each unit of distance in world space appears as 3 pixel lengths on the screen. Which mipmap should be used for texturing the polygon? Show your working, and assume nearest_mipmap_nearest as the texture interpolation mode.

Question 3:

Consider the design of a triangle mesh data structure for representing terrain. The data structure must support the following algorithms:

- It will be drawn with Gouraud shading, and the shading should appear to be smooth and without discontinuities at the boundaries between triangles.

- Vehicles will be animated on the terrain by tracking which triangle they are in, and the height of that triangle at the vehicle's location. As the vehicle moves, the algorithm will check whether it has left its current triangle, and if so, it will find the triangle that the vehicle now occupies. This must be cheap to compute.

Design a polygon mesh data structure for the terrain. Indicate the classes you would use and the information you will store in each class. Pay particular attention to which features of the mesh you explicitly store, and which relationships between features. Do not worry about syntax – we care only about the information you choose to store.

Question 4:

A student is planning a polygon mesh data structure in which vertices are stored in a vertex array, and then the triangular faces in the mesh each store the indices of the vertices and the triangle's face plane normal vector. The face data structure is given below.

```
class Triangle {
        int     vertices[3]; // The vertex indices.
        float   nx, ny, nz; // The face-plane normal.
};
```

- a. Is this a convenient way to represent a mesh if used with flat shading? Explain your reasoning.

- b. Suggest an object for which this is a good mesh format when used with Gouraud shading. Explain.

- c. Suggest an object for which this is a bad mesh format when used with Gouraud shading? Explain.