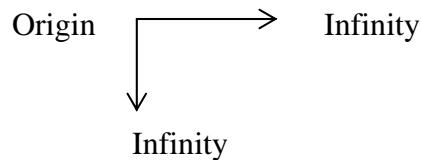


CS 112: Introduction to Computer Graphics (Fall 2008)
Written Assignment 1 (Total Points = 55)
Due: Monday, 13 Oct, 2008, 11am PST
Estimated Time: 2 hrs

Rendering Pipeline

1. Draw the rendering pipeline and explain, in your own words, each stage of the pipeline. [10]
2. Define (a) Pixel, (b) Rendering, (c) Rasterization [2+2+2=6]
3. Many image files have linear structure. If the size of the image is 1000x1000 (WxH), then the element at position 3500 in the file would refer to the element in the fourth row and 500th column of the image. If the size of the image is infinite in both width and height, but has an origin (refer to the figure), then how would you organize your file into a linear structure? In other words, come up with a scheme of organizing the data in the file such that given the position of the element in the file, you can locate the corresponding position in the image. [5]



Polygonal Representation

1. What is the dimension of a *point*, *line*, and a *triangle* in a 3D space? [1+1+1=3]
2. A plane is defined by the equation $ax+by+cz = d$. What kind of representation of the plane (implicit, explicit or parametric) is this? What is the significance of the vector (a,b,c) in this equation? Can you convert this representation to any of the other two representation of the plane? If so, how? [2+2+2=6]
3. Define manifold, manifold with boundary. Give (draw) examples for each of them. [3+3=6]
4. The euler characteristic e is given by $e = V-E+F$ where V , E and F are the number of the vertices, edges and faces of the polygonal object. What is the Euler characteristic of a cube represented by six planar quadrilaterals? Euler characteristic is related to the genus by the formula $e=2-2g$. Can you derive the genus of a sphere from the euler characteristic of the cube? If so, how? [2+4=6]
5. A cube is an approximation of a sphere using faces having four edges each (quadrilaterals). In such a cube, all vertices have degree three. My claim is that you can construct an approximation of a sphere using quadrilaterals such that the degree of every vertex is four. Prove or disprove this claim. [6]
6. In computer graphics, objects like spheres are usually approximated by simpler objects constructed from flat polygons. Start with a regular tetrahedron, which is constructed from four triangles. Derive an algorithm for obtaining a closer approximation of a sphere, based on subdividing the faces of the tetrahedron. Does this construction change the topological properties of the sphere? [6+1 = 7]