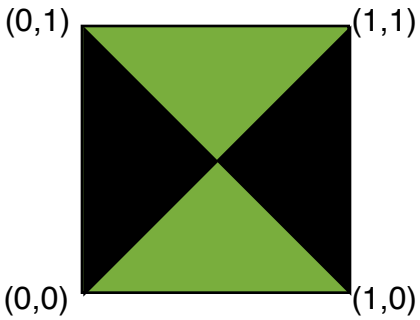
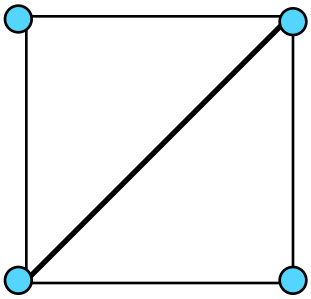
Homework #3
Texture Mapping and Ray Tracing
Due Thursday, November 8 by the end of class
(Grade out of 100 points)

Question #1 - Texture Mapping: (30 points)

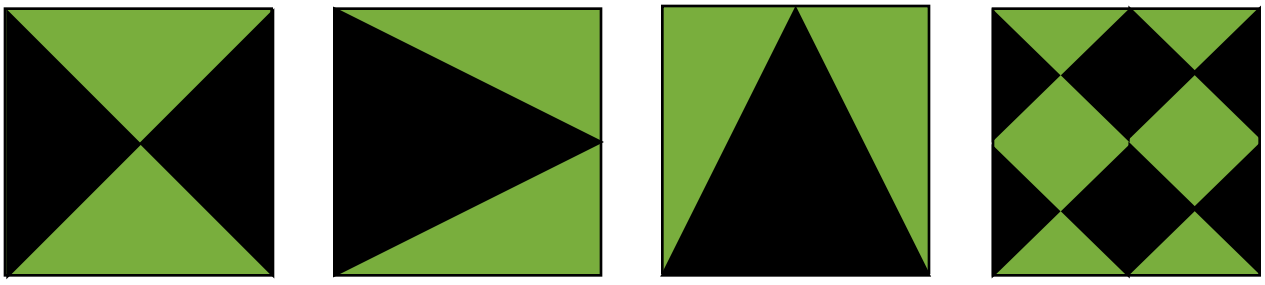
Assume that you are given the following texture:



And you want to map it onto two triangles arranged as follows:



For each of the following questions, I will give you the rendered image that is desired. Please give the (u,v) texture coordinates for each of the 4 triangle vertices that would result in that image. (7.5 pts each)



(a) (b) (c) (d)

Question #2 - Ray-Object Intersections: (30 points)

For each part, solve for the ray-intersection equation with the following geometric shape. (In the form t = f(x, y, z))

(a) Infinite planes in the xz-plane
(b) Rectangles in the xz-plane (defined by (x_1, y_1): lower left corner, (x_2, y_2): upper right corner)
(c) Circular discs in the xz-plane (defined by (x_1, y_1): center, r: radius)

Question #3 - Generating Rays: (30 points)

Build the camera matrix for a camera located at (4, 3, 0) looking at the origin (0, 0, 0). Its field of view is 60°, the resolution of the final image is 800x600. The up vector is the positive y-axis, (0, 1, 0).

Question #3 - Refracting Rays: (20 points)

Assume that you have one object in your scene: a unit sphere made of glass (refractive index n=1.5), located at the origin. The sphere is surrounded by air (n = 1). Consider a single ray incident on the sphere, originating from (3, 3, 3) and directed toward the origin (0, 0, 0). Using Snell's law (from the October 23 slides), compute:

(a) the new ray inside the sphere (point and vector) (10 pts), and
(b) the ray that exits the sphere (point and vector) (10 pts)