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)
**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 \(60^\circ\), 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)