

CMSC 435/634: Problem Set 1  
Due February 22, 2012 (at beginning of class)

Consider a scene to be raytraced. The model has been transformed into view space; specifically, the eye point  $\mathbf{E}$  is at  $(0,0,0)$ , the vector  $\mathbf{v}=(0,1,0)$  points up, the vector  $\mathbf{u}=(1,0,0)$  points to the right, and the vector  $\mathbf{w}=(0,0,1)$  points opposite the view direction. The view plane has extent  $(-5.5, -5.5)$  to  $(5.5, 5.5)$  and is divided into 11 pixels in each direction (indexed 0 to 10). The view plane is at a distance 10 from the eye point. The background color is  $(1,1,0)$ .

There are three spheres in the scene. Sphere  $\mathbf{s1}$  has radius 2 and center point at  $(-1,-1,-14)$ . It is blue. Sphere  $\mathbf{s2}$  has radius 1 and center point at  $(0,0,-12)$ . It is red. Sphere  $\mathbf{s3}$  has radius 4 and center point  $(2, 0, -20)$ . It is green.

1. Construct the ray through the center of pixel  $(6,6)$ .
  - a. Describe the ray parametrically.
  - b. Intersect that ray with the objects in the scene. Give the parameter and coordinates of each intersection. Indicate which is the closest intersection. What color is the resulting pixel?
2. Repeat for the ray through pixel  $(8,6)$ .
  - a. Describe the ray parametrically.
  - b. Intersect that ray with the objects in the scene. Give the parameter and coordinates of each intersection. Indicate which is the closest intersection. What color is the resulting pixel?

Now assume that the scene is not in view space (ie, the eye point is not at the origin). The view is specified by eye point  $\mathbf{E}$  is at  $(10,0,-14)$ , the vector  $\mathbf{v}=(0,1,0)$  points up, the vector  $\mathbf{u}=(0,0,-1)$  points to the right, and the vector  $\mathbf{w}=(1,0,0)$  points opposite the view direction. The view plane is the same size and distance from the eye as above.

3. Using this new view specification, construct the ray through the center of pixel  $(6,6)$ .
  - a. Describe the ray parametrically.
  - b. Intersect that ray with the objects in the scene. Give the parameter and coordinates of each intersection. Indicate which is the closest intersection. What color is the resulting pixel?