CS 465 Homework 3a

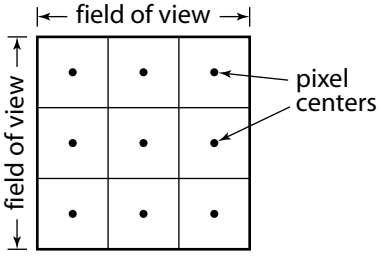
out: Monday 29 September 2003
due: Monday 6 October 2003

Problem 1: Eye ray generation

Consider a camera with the following intrinsic parameters:

- 90° field of view;
- square aspect ratio (horizontal f.o.v. equals vertical f.o.v.).

We are using this camera to render a 3 by 3 pixel image. The convention for the locations of pixels in the image is (as in Shirley, p. 50) that the pixel areas tile to cover the image and the pixel locations are at the centers of the areas:



Consider the following three specifications of the camera pose:

1. The camera is at $(0, 0, 0)$, facing in the $-z$ direction, with the $+y$ direction up.
   (a) What are the camera's basis vectors?
   (b) What are the rays for the pixels $(1, 1)$ (the center pixel) and $(0, 0)$?
   (c) What is the ray for the lower-left corner of the field of view?
2. The eye point is $(0, 5, 5)$, the target point is $(0, 0, 0)$, and the up vector is $(0, 1, 0)$.
   (a) What are the camera's basis vectors?
   (b) What are the rays for the pixels $(1, 1)$ and $(0, 0)$?
   (c) What is the ray for the top center of the field of view?

3. The camera is at point $\mathbf{o}$ and its basis is $\{\hat{\mathbf{u}}, \hat{\mathbf{v}}, \hat{\mathbf{w}}\}$.

   (a) What is the ray for the pixel $(1, 1)$?

   (b) What is the ray for the pixel $(0, 0)$?

Your camera basis vectors should be normalized. Your ray direction vectors do not need to be—instead, just leave them as the difference of a point on the image plane and the viewpoint. For the first two parts, keep the vectors in terms of fractions and square roots, rather than writing them numerically. (*Hint:* the numbers work out reasonably nicely.)