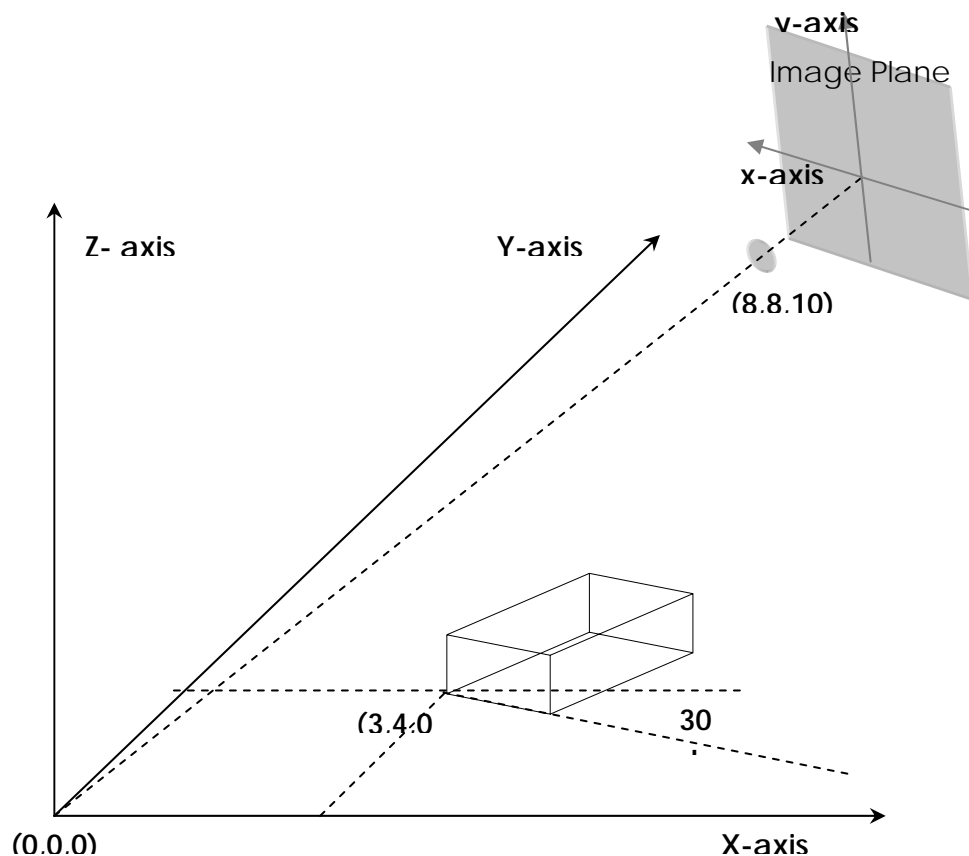


CSCI 574: Computer Vision, Fall 2007, Prof. Nevatia
Assignment #1
Due: Wednesday, September 12, 2007

Consider a rectangular block of size (1, 2, 3) placed in a room. Let a right-handed, orthogonal room coordinate system be defined by lines formed by the intersection of two walls and the floor in the room. Imagine that the block is first placed such that its largest face is on the floor, the longest lines are along the y-axis and the closest vertex to the origin is at location (3, 4, 0) in the room coordinate system. Now imagine that the block is rotated about a vertical axis through the point (3, 4, 0) by 30 degrees in the clock-wise direction; resulting configuration is shown schematically in the figure below.

Now consider a camera located so that the lens center is at (8,8,10), in the room coordinate system, with the principal ray pointing toward the origin (0,0,0) of the room system. Let the image plane be located a distance of 2 units away from the camera. We set the principle point of the camera to be the origin of the image plane, and the x-axis of the image plane to be parallel to the floor of the room.



The goal of this assignment is to compute the image of the block in the given configuration. Specifically, do the following:

- a) Compute the transformation matrix, \mathbf{M} , that gives the coordinates of the image point p_i for a 3-D point P expressed in the room coordinate system.
- b) Apply \mathbf{M} to compute the image points corresponding to the eight corners of the block described above. Draw the block in the image plane. Ignore occlusions and assume that all eight corners are visible.
- c) Now suppose that the image coordinates are measured in a slightly different coordinate system (U,V) . The origin of (U,V) coordinate system is at location $(-1, -1)$ relative to the xy -coordinate of the image plane. U -axis is parallel to the original x -axis of the image plane; V -axis makes an angle of 275 degrees with x -axis (positive angle is measured in the direction from x -axis to y -axis). Compute the transformation matrix, \mathbf{M}' , that gives the (U, V) coordinates of the image for a point P expressed in the world coordinate system. Hint: You should be able to compute \mathbf{M}' , by applying an additional transformation to \mathbf{M} .
- d) Compute the new image coordinates for the eight points of the block.