ENGN6528 Practice Exercise – Week 1-2

Question 1: Why can we use a pinhole camera model to approximate the geometric image formation process?

Question 2: Given a lens with a focal length of 30, and a world point at (20,20,200), where the camera center sits at (0,0,0), and the optical axis is in direction (0,0,1), with the x and y axes aligned to the world axes, what pixel will this world point project to?

Question 3: Given RGB value (25,30,40), what would the pixel value be in YUV and HSV space? In HSV? See slide 72.

Question 4: Why is it important to have a monotonically increasing histogram mapping (transformation) function for image enhancement?

Question 5: Image warping can be performed by pre-multiplying coordinate locations by a 2x2 matrix, and adding for translation. What would the effect be of the following transformation:

$$\begin{bmatrix} x' \\ y' \end{bmatrix} = \begin{bmatrix} a_{11} & a_{12} \\ a_{21} & a_{22} \end{bmatrix} \begin{bmatrix} x \\ y \end{bmatrix} + \begin{bmatrix} d_x \\ d_y \end{bmatrix}$$

Where a_{11}=2 and a_{12}=0, a_{21}=0, a_{22}=1, d_x=1, d_y=2.

Question 6: Homogeneous coordinates simplify representation by allowing 2D image transformations to be represented by a single matrix operation (3x3). What are the effects of the following transformations:

(1)

$$\begin{bmatrix} x' \\ y' \\ 1 \end{bmatrix} = \begin{bmatrix} 1 & 0 & t_x \\ 0 & 1 & t_y \\ 0 & 0 & 1 \end{bmatrix} \begin{bmatrix} x \\ y \\ 1 \end{bmatrix}$$

Where t_x=1 and t_y=2

(2)

$$\begin{bmatrix} x' \\ y' \\ 1 \end{bmatrix} = \begin{bmatrix} \cos\Theta & -\sin\Theta & 0 \\ \sin\Theta & \cos\Theta & 0 \\ 0 & 0 & 1 \end{bmatrix} \begin{bmatrix} x \\ y \\ 1 \end{bmatrix}$$

Where theta = 45 degrees.

(3)

$$\begin{bmatrix} x' \\ y' \\ w \end{bmatrix} = \begin{bmatrix} a & b & c \\ d & e & f \\ 0 & 0 & 1 \end{bmatrix} \begin{bmatrix} x \\ y \\ w \end{bmatrix}$$

Where c=1, f=2, a=e=cos45, b=-d=sin 45?

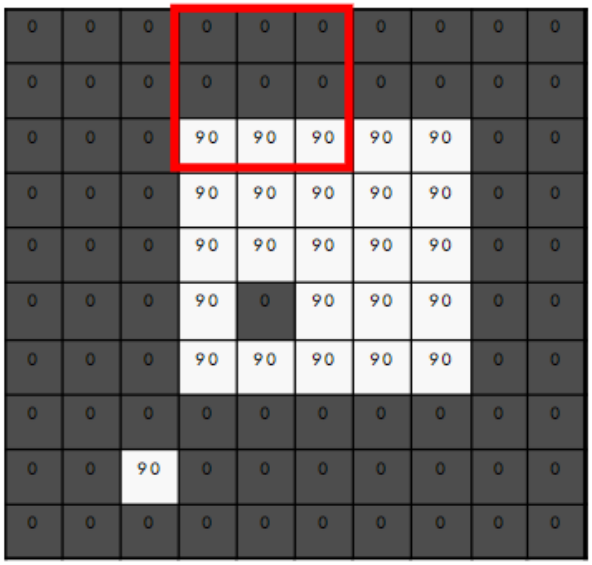
What generally can be represented by this transformation?

Suppose we have translation of (1,2), rotation of 25 degrees, and scaling of (2,1). What is the resulting transformation matrix?

Question 7: If you were to apply the filter as a convolution:

1	-1	-1
1	2	-1
1	1	1

to the image:



Where the red square is shown, and to the next location to the right, what would be the results.

What would the results be if it were a correlation?

Suppose we apply a linear filter f, followed by another linear filter g.

Show that it is possible to construct a linear filter h that performs the same as f o g.