ECE415 – HOMEWORK 2

Fall 2019

Problem 2 (10 points)

An 7x7 image of a light gray object on the dark gray background is given below:

37	37	37	37	37	37	37
37	37	37	37	37	37	37
37	37	37	37	37	37	37
37	37	125	125	37	37	37
37	37	37	125	37	37	37
37	37	37	37	37	37	37
37	37	37	37	37	37	37

Assume that spatial coordinates of image pixels when represented in Cartesian system are (x,y) where x represents the row and y the column. Assume that the top left pixel has the spatial coordinates (1,1) in Cartesian system.

a) What are Cartesian coordinates of the pixels in the object?
b) Represent the spatial coordinates of the pixel in the object in homogeneous system, under assumption that $\widetilde{w} = 2$.
c) Represent the spatial coordinates of the pixels in the object in homogeneous system as augmented vectors.
d) What are the spatial coordinates in Cartesian system of the pixels in the object after applying the following transformation matrix:

$$\begin{bmatrix} 1 & 0 & 2 \\ 0 & 1 & 1 \\ 0 & 0 & 1 \end{bmatrix}$$

Show all the steps in your computation for full credit, not just the final result!
e) What transformation does the matrix corresponds to?
f) What would be the transformation matrix in homogeneous coordinates that corresponds to the rotation by the angle of 45°?
g) What would be the spatial coordinates in Cartesian system of the pixels in the object after applying the rotation? Show all the steps in your computation for full credit!
h) Assuming affine transformation represented by the following transformation matrix:

$$\begin{bmatrix} 0.5 & -2 & -1 \\ 0.5 & 1 & 1.5 \\ 0 & 0 & 1 \end{bmatrix}$$

How can the rotation and affine transformation be performed in a single step (assuming affine transform is performed first, and rotation second)?
i) What would be the Cartesian coordinates of pixel (4,3) after this transformation? Show all the steps in your computation for full credit!