ECE415 – HOMEWORK 1

Fall 2017

Problem 1

1) Write a Matlab program that takes in as an input up to 4 polygon vertices in Cartesian coordinates (x,y). It should also take as an input a matrix that can describe any of the following 2D transformations in homogeneous coordinates: translation, Euclidian, similarity, affine or projective. Note that all the transformations must be performed in homogeneous coordinates.
    a. Input Cartesian coordinates for an equilateral triangle
    b. Select appropriate matrices for each type of 2D transformation. Perform all the above-mentioned transformations on the triangle. Plot the original triangle and transformed triangles for each transformation.
    c. Input Cartesian coordinates for a square
    d. Perform the same transformations on the square using the same matrices as in b). Plot the original square and transformed squares for each transformation.
2) Modify the program in part 1) so that it reads in as input a black and white image, scans through all its pixels starting with the top left corner and then scanning row by row from left to right. It still also takes as an input a matrix that describes the 2D transformation. Apply each of the above transformations using the same matrices as in part 1) to each of the pixels. Plot the original image and transformed images for each transformation.
   Hints:
    - Apply the transformation only on the black pixels, i.e. when scanning first check if the pixel is black before applying the transformation.
    - Round off the transformed pixel coordinates to get integer values.
    - Initialize the output image to all white pixels, and then only make pixels at coordinates obtained from the transformation black.
    - The original and modified image can be displayed using Matlab function imshowpair(A,B,'montage').

Submission should include the following:

- Page 1: Give matrices used in transformations, the vertices' Cartesian and homogenous coordinates of the input triangle and square, as well as Cartesian and homogeneous coordinates of vertices of transformed triangle and square.
- Page 2: Plots for part 1b - six plots total. Comment on what characteristics of the shape have been preserved by each transformation.
- Page 3: Plots for part 1d - six plots total. Comment on what characteristics of the shape have been preserved by each transformation.
- Page 4: Plots for part 2 - six plots total. Comment on the changes that shape underwent after each of the transformations.
- Page 5+: Matlab code printout for part 1 and part 2

Note: All plots must have clearly labeled axis, and a meaningful title.