Q1. a. Perform histogram equalization (HE). Assume bit depth to be 2. [1]

r	p(r)
0	0.4
1	0.2
2	0
3	0.4

Give the output pixel values.

b. Write a code to perform HE for part a. You can refer to the lecture notes. [2]

Q2. Suppose for histogram processing, the output histogram is given as [2]

$$p_s(s) = s$$

Find the transfer function $T(r)$, which will map the input pixels r to output pixels s such that the output will have histogram $p_s(s)$.

Q3. Find T for the following points:

U = {(10, 15), (8, 3), (11, 17), (5, 11), (6, 13)}

X = {(33, 20), (18, 7), (37,22), (20, 13), (23, 16)}

Assume U to be the coordinate of input image and X to be coordinates of points in output image, and U and X are related by geometric/affine transform T as

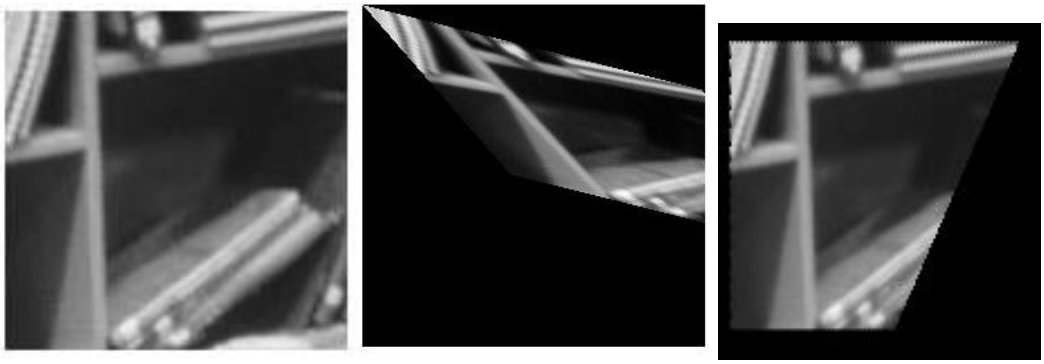
$$U \overset{T}{\rightarrow} X$$

Q4. Given the cameraman image, apply T obtained from Q3 on this image. [4]

Consider image on left to be input, the middle one shows how the output image looks like after performing transformation. Only the last quadrant is displayed.

Your code should clearly show input grid, output grid, mapping from output to input grid and interpolation. For interpolation, a standard library can be used (as also demonstrated in lectures).

Save the output image in .jpg format. Now read this image as input image and apply inverse T transformation. The output would look like right image. Only the last quadrant is displayed.



Q5. Given a transformation matrix

$$\begin{bmatrix} 2 & 0 & 0 \\ 0 & 1 & 0 \\ 10 & 10 & 1 \end{bmatrix}$$

Assuming that first scaling is performed followed by translation, find the respective parameters. [1]