Homework #1

2023 EE402
Digital Image Processing

1. (20 pts) You are preparing a report and have to insert in it an image of size 2048 × 2048 pixels.
   a) Assuming no limitations on the printer, what would the resolution in line pairs per mm have to be for the image to fit in a space of size 5 × 5 cm?
   b) What would the resolution have to be in dpi (dots per inch) for the image to fit in 2 × 2 inches?

2. (30 pts)
   a) Suppose that a flat area with center at (x_0, y_0) is illustrated by a light source with intensity distribution
   $$\mathrm{i}(\mathrm{x}, \mathrm{y}) = Kexp(-[(x - x_0)^2 + (y - y_0)^2])$$
   Assume for simplicity that the reflectance of the area is constant and equal to 1.0, and let K=255. If the intensity of the resulting image is quantized using k bits, and the eye can detect an abrupt change of eight intensity levels between adjacent pixels, what is the highest value of k that will cause visible false contouring? (15 pts)
   b) Sketch the image in (a) for k=2. (15 pts)

3. (30 pts) Consider the image segment shown in the following figure.

3	1	2	1(q)
2	2	0	2
1	2	1	1
(p)1	0	1	2

   a) Let V={0, 1} be the set of intensity values used to define adjacency. Compute the lengths of the shortest 4-, 8-, and m-path between p and q. If a particular path does not exist between two points, explain why. (15 pts)
   b) Repeat (a) but using V={1, 2}. (15 pts)

4. (80 pts) Write a MATLAB program for the affine transformation for scaling.
   a) The program should consist of two files named main.m and Scaling.m provided with this homework question. The main.m should call the function in Scaling.m that is responsible for increasing the image and spatial transformation of coordinates. Show the result of you program. (20 pts)
   b) Discuss the difference between the results obtained by your program and MATLAB functions (i.e., affine2d(…) function). (10 pts)
   c) Explain the bilinear interpolation and write a program for the bilinear interpolation which should be in the Bilinear_Interp.m file. Your main function should use this function to improve the quality of the scaled image obtained in (a). Discuss the effect of the bilinear interpolation on the image quality (50 pts).