CS-111: Written Assignment 3

Questions:

1) Consider a JPEG compression pipeline using 4x4 image blocks instead of 8x8. The coefficients generated by performing a DCT on a 5x5 block of luminance values are given by: **[5+5+4+4=18]**

140	20	8	5
23	18	7	8
15	10	6	2
9	5	1	2

The quantization table you are given is:

| 5	12	16	30
12	14	20	30
14	20	32	35
20	25	29	40

a) Generate the values of the image after quantization.
b) This quantized table is then transmitted by linearly ordering the 4x4 matrix into a 1-D array of size 16. In what order will the quantized table be transmitted and why? Write out the linearly ordered sequence.
c) What will be the run length encoding of this 16-element one-dimensional array?
d) When multiple such spatially neighboring 4x4 blocks are transmitted, what kind of additional compression schemes can be applied? Justify your answers.

2) Consider the text "*No worry and be merry*". **[2+5+10+3=20]**
   a) How many characters (including spaces) does this text have?
   b) What is the probability of occurrence of each character?
   c) Using these probabilities, construct the Huffman coding table for transmitting this text.
   d) What will be the final code that will be transmitted using this table for this text?

3) Shown below is a binary image with some disks and squares, some of which overlap. For each question provide an algorithm that uses morphological and logical operations to achieve the tasks mentioned. The answers may be in the form of pseudocode with a block diagram. Assume all disks are the same size and all squares are the same size. **[3+3+4=10]**
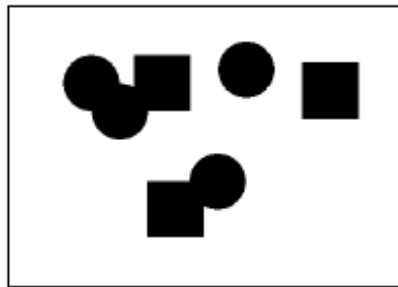
   a) How many disks are there in this image?
   b) How many pixels form the boundary of a disk or a square?
   c) Which pixels lie in the overlap region of two different objects?

4) Consider the figure below. A sequence of transformations must be performed to transform the quadrilateral *ABCD* to the new quadrilateral *A'B'C'D'* **[5+10+5=20]**.
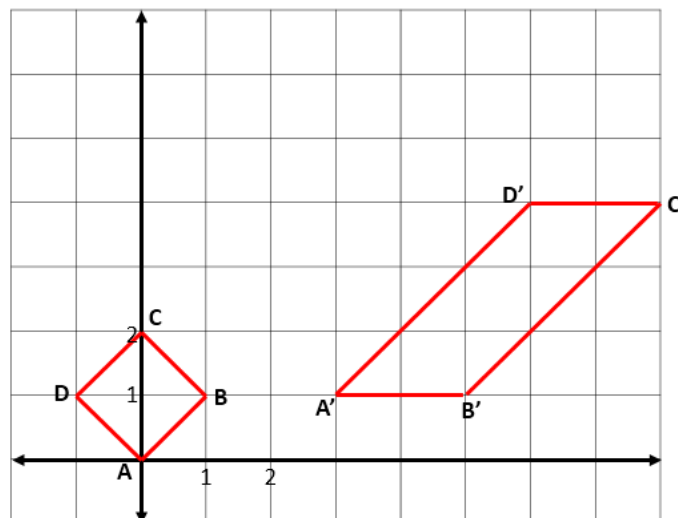
   a) List the transformations (choose from rotation, translation, scale, shear) that must be applied sequentially, in the correct order, to perform this transformation. Note: you must list the transformations in the order that they must be applied.
   b) Provide the transformation matrices for the transformations you listed in (a).
   c) Compute the single transformation matrix that performs the entire operation.

5) For each of the images in the table, provide the morphological operation that was applied on the input image to get the corresponding output **[2+2+2+2+2=12]**.
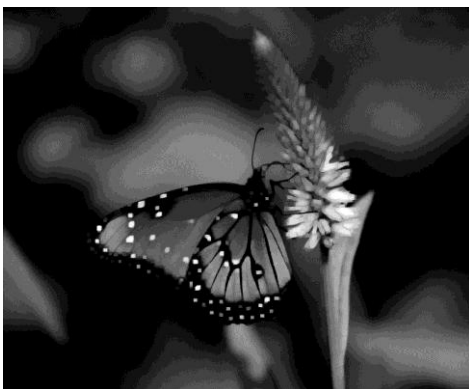

Input image

(a)

(b)

(c)

(d)

(e)

(f)

6) Consider a device with (R, G, B) chromaticity coordinates of (0.6, 0.3), (0.4, 0.5) and (0.2, 0.1) respectively. The maximum intensities for the R, G and B channels are 100, 400, and 300 respectively **[3+2+3+9+3=20]**.
   a) What is the white point of this device?
   b) What is the intensity of the white of this device?
   c) What is the luminance of each of the R, G and B channel?
   d) Find the color matrix for this device.
   e) What is the XYZ value of the color generated by the input (0.2, 0.7, 0.1) in this device?