The LNM Institute of Information Technology, Jaipur
Digital Image Processing (DIP)
End Semester Examination, 2013 – 2014

MM: 50 **Duration: 3 hrs**

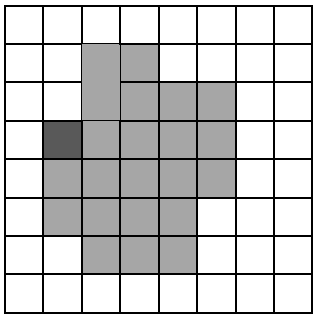
PART A

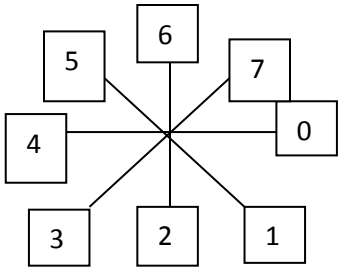
Q1. Compute Laplacian $h(x, y)$ of Gaussian $G(x, y)$ as $h(x, y) = \frac{\partial^2 G}{\partial x^2} + \frac{\partial^2 G}{\partial y^2}$ and

$$G(x, y) = e^{\frac{-(x^2+y^2)}{\sigma^2}}$$ [3]

Q2. Compute $f * g$, where, $f(i)=4i-10 \quad 0 \le i \le 5$ and $g(i)=2-|1-i| \quad 0 \le i \le 2$ [3]

Q3. Consider the following figure: [2+2=4]





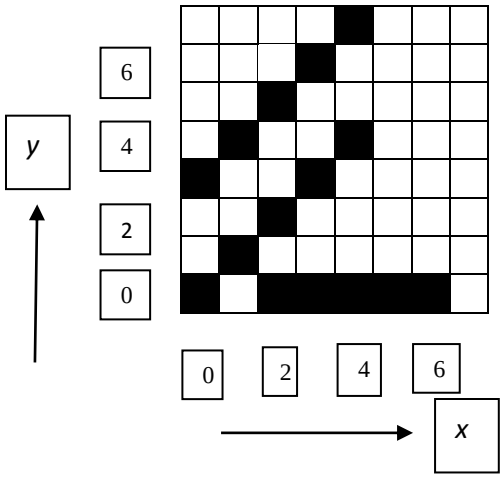
a) Draw quad-tree representation.

b) Starting with dark gray cell (4,2), write 8-connected chain code and derive shape number. Use the given directions.

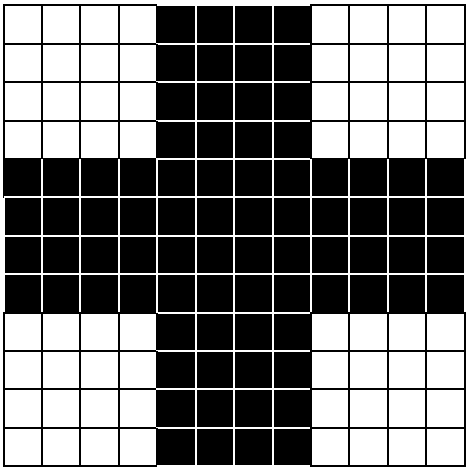
Q4. Determine the signature of an equilateral triangle with respect to its centroid. It is given that D_0 is the perpendicular distance from the centroid to one of the sides of the triangle and D is the distance of centroid to its vertex. [4]

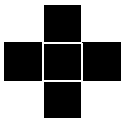
Q5. Obtain the gray-level co-occurrence matrix of a 5 x 5 image composed of a checkerboard of alternating 1's and 0's (assume top left pixel has value 0) if the position operator is defined as "two pixels to the right". [3]

Q6. For the figure shown below, represent the values in the accumulator i.e.***m-c*** space (after Hough transform) for specified values of ***m*** and ***c***. (***m***={-1,0,1} and ***c***={0,1,2,3}). Use the accumulator to detect lines (a line should have four or more pixels). [4]



Q7. Consider Set *A* as shown below. Determine $(A \ominus B^1) \ominus B^2$. [4]





Set B^1

Set B^2

PART B

Q8. Assume you are given an image that suffers from the following problems related to image quality.

- The image does not have enough contrast. Most areas in the image appear to be too bright.
- The structures and boundaries in the image are blurred and thus it is hard to see the details of objects in the image.
- There are random sparse black spots (pepper noise) that seem to be caused by some electronics noises.

You are asked to propose a system that use techniques you have learned in this class to improve the overall image quality. Please design a conceptual diagram for a quality enhancement system that addresses all the problems mentioned above. Provide justifications for the use of each component and the specific order you adopt in combining different components. Try to provide as much information as needed. For example, if you use contrast stretching, specify the shape of the intensity mapping function. If you use sharpening filters, specify the specific type of filter you will use. **[6]**

Q9.

0	0	0	0	1	2	4	6
0	0	0	0	1	2	4	6
0	0	0	0	1	2	4	6
0	0	0	0	1	2	4	6
1	1	1	1	1	2	4	6
3	3	3	3	3	2	4	6
5	5	5	5	5	5	4	6
7	7	7	7	7	7	7	6

a. Compute the intensity histogram for the image above. Using this, calculate the Huffman code tree (Huffman coding). What are the resulting Huffman codes for each pixel value?
b. Calculate the average number of bits per pixel needed to compress this image using the above Huffman codes? **[2+5+2]**

Q10. Which are the 3 basic redundancies that can be identified in digital images? Explain with the appropriate examples. How can these redundancies be reduced or eliminated? **[3+2]**

Q11. Assume that you are given an input image that is of size 100*100 and you want to create an output image that is of size 300*300.

c. Describe how pixel replication could be used for this process.
d. Describe how bilinear interpolation could be used for this process.
e. What are the advantages and disadvantages of each method? **[2+2+1]**