BITS PILANI DUBAI CAMPUS

BITS Pilani
Dubai Campus

DUBAI INTERNATIONAL ACADEMIC CITY, DUBAI UAE

I SEM 2013-2014

Evaluation Component:	COMPRE EXAM	Date/Time/Duration	**05-01-2014 / AN**
Course No :	**EA C443**	Course Name :	**IMAGE PROCESSING**
Maximum Marks :	**40**	Weightage :	**40%**

Note: Answer all the questions and any missing data can be assumed suitably

Q.1 Given two histograms of the image shown below, modify the histogram (a) to match the histogram (b) — 6M

Histogram (a)=

Gray	0	1	2	3	4	5	6	7
No. of Pixels	790	1023	850	656	329	245	122	81

Histogram (b)=

Gray	0	1	2	3	4	5	6	7
No. of Pixels	0	0	0	614	819	1230	819	614

Q.2 Show that a 2D high pass filtered image can be obtained in the spatial domain as — 4M

$$High\ pass = Original - Lowpass$$

Given Original image as

z_1	z_2	z_3
z_4	z_5	z_6
z_7	z_8	z_9

Q.3 Perform the intensity level slicing on the following image (4 bits per pixel). Let r1=4 and r2=10. Draw the modified image using with background and without background transformation. — 4M

14	13	6	6	9	3	4	2
15	4	13	9	8	10	14	15
9	14	9	2	1	4	3	1
3	6	9	1	6	10	13	12
3	3	14	8	3	11	9	13
4	4	5	12	12	12	15	14
13	10	12	15	5	7	2	2
4	8	12	2	8	2	7	6

Q.4 Given following 4x4 image, what would be the effect on the histogram, if we set higher order bit planes to zero? — 4M

0	1	2	3
4	5	6	7
8	9	10	11
12	13	14	15

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Q.5	Consider following 8x8 image, draw the quad tree diagram after applying region splitting. Let the predicate be threshold $max\{g(x,y)\} - min\{g(x,y)\} \leq 3$ 5 6 6 6 7 7 6 6 6 7 6 7 5 5 4 7 6 6 4 4 3 2 5 6 5 4 5 4 2 3 4 6 0 3 2 3 3 2 4 7 0 0 0 0 2 2 5 6 1 1 0 1 0 3 4 4 1 0 1 0 2 3 5 4	4M
Q.6	Show that subtracting the Laplacian from an image is proportional to unsharp masking.	3M
Q.7	An image , which requires 2bits per pixel , has following source probabilities. S0 0.1 S1 0.4 S2 0.3 S3 0.2 Given following image, apply arithmetic coding to the pixel sequence 1,1,0,3,2.	4M
Q.8	Show that radon transform of the Gaussian shape $f(x,y) = Ae^{(-x^2-y^2)}$ is $g(\rho,\theta) = A\sqrt{\pi}e^{-\rho^2}$	4M
Q.9	During acquisition, an image undergoes uniform linear motion in the horizontal direction for a time T_1 at a rate of at/T_1. The direction of motion then switches to vertical direction for a time interval T_2 with a rate of bt/T_2. Assuming that the time it takes the image to change direction is negligible, and that shutter opening and closing times are negligible, give an expression for the blurring function. Note: Consider x direction for horizontal motion and y direction for vertical motion.	4M
Q.10	Given following 3x3, image find the value of the center pixel when the image is filtered by following noise only filters 8 0 9 6 1 10 9 0 10 I. Harmonic mean filters II. Contraharmonic mean filter (with Q=2) III. Alpha trimmed mean filter (d=4)	3M

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Evaluation Component:	**TEST 2 (OPEN BOOK)**	Date/Time/Duration	**06-11-2013 / 12:15PM/ 50Min**
Course No :	**EA C443**	Course Name :	**IMAGE PROCESSING**
Maximum Marks :	**25**	Weightage :	**25%**

Note: Answer all the questions and any missing data can be assumed suitably

Q.1 Determine the magnitude of 2D DFT of the following image : **5.5M**

0	1	3	1
1	2	3	2
3	3	2	3
1	2	3	2

The 1D DFT matrix is given by

1	1	1	1
1	-j	-1	j
1	-1	1	-1
1	j	-1	-j

Q.2 Demonstrate the shifting property of 2D DFT for the following 4x4 image (use shifting by N/2) **6M**

0	1	2	1
1	2	3	2
2	3	4	3
1	2	3	2

Q.3 Apply Alpha-trimmed mean filter mean filter to the following noisy image with d=4 **4M**

2	80	3
4	56	4
4	45	5

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<table>
<tr><td>Q.4</td><td>Referring to the Contraharmonic filter
a) Explain why the filter is effective in elimination of pepper noise when Q is positive
b) Explain why the filter is effective in eliminating salt noise when Q is negative.
c) Explain why the filter gives the poor results , when the wrong polarity is chosen for the Q
d) Discuss the behavior of the filter when Q=-1
e) Discuss the behavior of the filter in the areas of the constant intensity levels.</td><td>4.5M</td></tr>
<tr><td>Q.5</td><td>Given following 8x8 with 8 intensity levels image , apply Huffman coding technique and calculate the compression ratio
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Evaluation Component:	**TEST 1**	Date/Time/Duration	**02-10-2013 / 12:15PM/ 50Min**
Course No :	**EA C443**	Course Name :	**IMAGE PROCESSING**
Maximum Marks :	**20**	Weightage :	**20%**

Note: Answer all the questions and any missing data can be assumed suitably

Q.1 Compute the median value of the marked pixels shown in the figure below using 3x3 mask — 3M

18	22	33	25	32	24
34	~~128~~	~~24~~	~~172~~	~~26~~	23
22	19	32	31	28	26

Q.2 Explain the following — 6M

i. Log transformation
ii. Power law transformation
iii. Contrast stretching
iv. Intensity level slicing

Q.3 A 4x4, 4 bits/pixel original image is given by — 5M

10	12	8	9
10	12	12	14
12	13	10	9
14	12	10	12

a) Apply histogram equalization to the image by rounding the resulting image pixels to integers.
b) Sketch the histograms of the original image and the histogram equalized image.

Q.4 The input mage f(m,n) is passed through a linear shift-invariant system h(m,n). Determine the output image if f(m,n) and h(m,n) is given below. — 4M

$$f(m,n)=\begin{vmatrix}12 & 10 & 8 & 9\\ 8 & 14 & 6 & 9\\ 5 & 9 & 13 & 8\\ 14 & 5 & 7 & 9\end{vmatrix} \quad and \quad h(m,n)=\frac{1}{4}\begin{vmatrix}0 & 1 & 0\\ 1 & 0 & 1\\ 0 & 1 & 0\end{vmatrix}$$

Assume zero padding of the original image.

Q.5 Prove that second derivative of the image will provide following filter mask — 2M

0	1	0
1	-4	1
0	1	0

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