Name: B.N.

Computer Engineering Department
Faculty of Engineering
Cairo University

Image Processing and Computer Vision (Elective 1)
Midterm Exam – 3rd Year – Fall 2013
(60 minutes) -*Total Marks: 20*

Question 1 (5)	Question 2 (5)	Question 3 (5)	Question 4 (5)	Total (20)

Question 1: [5 points] (T/F)

1. In practice, histogram equalization makes all colors have the same number of pixels. (**False**)

2. The blurring effect of a low pass filter can be reduced by convolving the blurred image with a high pass filter. (**False**)

3. Using a large window size in mean shift segmentation eliminates more outliers than smaller windows. (**False**)

4. Image resolution and image size are equivalent. (**False**)

5. A slow shutter speed should be used to capture a stable image of a computer monitor. (**True**)

6. Image smoothing and edge detection operations cannot be done in frequency domain. (**False**)

7. The retina in the human eye has higher density of photo receptors than the Fovea (**False**)

8. Image interpolation technique should be used whenever the image is geometrically transformed. (**True**)

9. Median cut algorithm can be used to represent the image using only two grey levels (image halftoning) (**False**)

10. To preserve horizontal and vertical lines while eliminating salt and pepper noise, we should use a 3x3 median filter. (**False**)

Question 2: [5 points]

2.a) [3 pt] In a certain application that required inspecting images from an electronic microscope, some of them suffered from the following problems. Can you suggest some image processing techniques that could be used selectively on each image to get rid of these problems?

a. Lack of sharpness due to out of focus lens

Use inverse Gaussian filter to deblur the image

b. Low contrast due to lack of light

Use histogram equalization

c. Low contrast of the light colors only

Use gamma correction technique with gamma>1

2.b) [2 pt] What is the maximum shutter time of your camera to be able to capture a sharp image for a ball moving at 100 meter/second. Assume pixel size = 100 micro.

The shutter should open and close faster than the ball speed and before the ball move a pixel. Thus the shutter time should be less than the following value

Shutter time < 100*10^-6/100 < 1 micro second

Question 3: [5 points]

3.a) [2 pt] For the shown co-occurrence matrix ($P_{0\ deg,1}$), propose the image that may generate such co-occurrence matrix. What should be the min and max grey levels in the image?

x→ / Y	0	1	2	3	4
0	**0**	**1**	**2**	**3**	**0**
1	**0**	**1**	**2**	**3**	**0**
2	**0**	**1**	**2**	**3**	**0**
3	**0**	**1**	**2**	**3**	**0**

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

Min = 0 and max=3

3.b) [3 pt] Propose a halftone image with two levels only (0 and 1) for the shown image. The image has 16 grey levels. Justify your answer and show your dither matrix.

1	1	1	1	8	8	8	8
1	1	1	1	8	8	8	8
1	1	1	1	8	8	8	8
1	1	1	1	8	8	8	8
7	7	7	7	4	4	4	4
7	7	7	7	4	4	4	4
7	7	7	7	4	4	4	4
7	7	7	7	4	4	4	4
5	5	5	5	3	3	3	3
5	5	5	5	3	3	3	3

Original Image

1	**0**	**0**	**0**	**1**	**1**	**1**	**1**
0	**0**	**0**	**0**	**1**	**1**	**1**	**1**
0	**0**	**0**	**0**	**0**	**0**	**0**	**0**
0	**0**	**0**	**0**	**0**	**0**	**0**	**0**
1	**1**	**1**	**1**	**1**	**1**	**1**	**1**
0	**1**	**1**	**1**	**0**	**0**	**0**	**0**
0	**0**	**0**	**0**	**0**	**0**	**0**	**0**
0	**0**	**0**	**0**	**0**	**0**	**0**	**0**
1	**1**	**1**	**1**	**0**	**1**	**1**	**1**
0	**0**	**0**	**1**	**0**	**0**	**0**	**0**

Halftone image

To represent 16 grey levels using two levels only, you need a 4x4 dithering matrix like the following:

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

Question 4: [5 points]

4.a) [2 pt] For the shown image, decide the radius value to use in the mean shift algorithm to obtain 3 segments; segment 1 has color (0, 4, 8), segment 2 has color (16, 20) and segment 3 has color (30, 32, 36, 40). Justify your decision.

0	8	16	20	32	40
0	8	16	20	32	40
0	8	16	20	32	40
0	8	16	20	32	40
4	20	20	30	36	40
4	20	20	30	36	40
4	20	20	30	36	40
4	20	20	30	36	40

The radius should be less than the minimum distance between the segments. So it is less than 8 to keep the three segments separated.

4.b) [3 pt] You are requested to insert invisibly the binary logo of your company into the upper right corner of an image. The image size is 7x7 and the logo size is 3x3. The image color is represented by 4 bits. The image and the logo are shown below. Show the resultant image. How the resultant image will look like if the logo should be visible with a blended mix of 50% image and 50% logo?

1	2	3	4	5	7	1
1	2	3	4	5	7	1
1	2	3	4	5	7	1
1	2	3	4	5	7	1
1	2	3	4	5	7	1
1	2	3	4	5	7	1
1	2	3	4	5	7	1

Image

1	0	1
0	1	0
1	0	1

Logo

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

Image+Invisible Logo

- **For invisible watermark, we use the LSB.**
- **For visible watermark, we blending a binary image with a grey image. Thus we represent the binary image as a grey image. 0 → 0 and 1 →15 (max grey level). Then we blend them 50% from each.**

1	2	3	4	**10**	**4**	**8**
1	2	3	4	**3**	**11**	**1**
1	2	3	4	**10**	**4**	**8**
1	2	3	4	5	7	1
1	2	3	4	5	7	1
1	2	3	4	5	7	1
1	2	3	4	5	7	1

50% Image+50% Logo