Model Answer

Cairo University
Faculty of Engineering
Computer Engineering Department

Image Processing
Midterm Exam
Fall 2018

Name:
ID:

Answer ALL Questions (Full Mark 40 points) **Time Allowed :1.5 Hour**

Question 1: True/False (15 points), correct the false sentences:

1- In HSV color model, hue is more meaningful when saturation approaches 1 and less meaningful when saturation approaches 0. (✓)

2- Color histogram is a local property of the image while edges are a global property. (✗)

3- Image compression is much simpler in spatial (freq) domain than in frequency domain. (✗)

4- Increasing the size of the low pass filter will enhance the quality of the output image (✓)

5- Canny operator does the same task as high pass filter but in spatial domain (✓)

6- Median filter is one of the (non) linear filters for noise removal. (✗)

7- The sum of all components of a normalized histogram is equal to one (✓)

8- In Canny edge detection, we will get more discontinuous edges if we increase the high (low) threshold (✗)

9- Suppose we have a 1D image with values as [2, 5, 8, 5, 2]. Now we apply average filter on this image of size 3. The value of the last second pixel will be decreased by 2 (same) (✗)

10- Increasing the size of the pinhole in a pinhole camera will cause that the output image be blurred while decreasing it will make it sharper. (both will blur) (✗)

11- Low pass filter In frequency domain can be used for Noise reduction (✓)

12- The edge direction at any point is perpendicular to the gradient vector at the same point (✓)

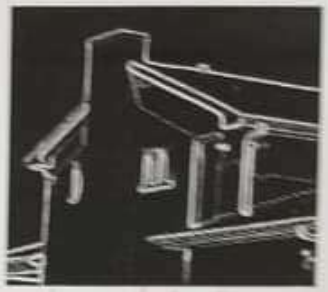
13- The first derivative (2nd) of the image function should have a zero at the position corresponding to the edge in the image (✗)

14- It is possible to blur an image using a linear filter (✓)

15- Canny edge detector removes streaking or broken edges by Non-maxima Suppression (Thresholding) (✗)

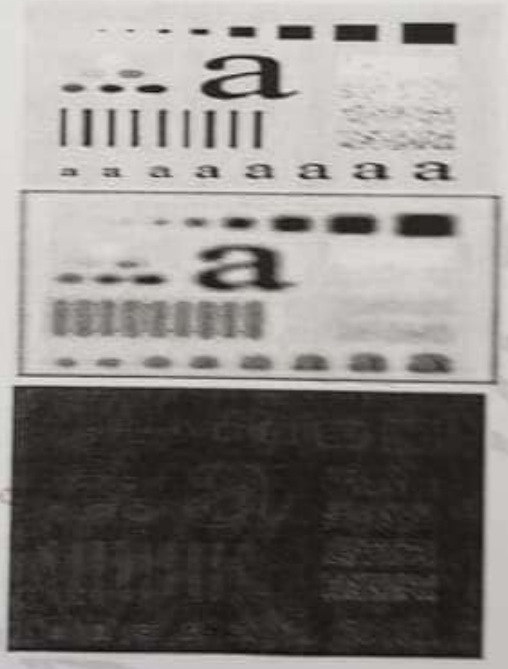
Question 2 (15 points):

1- **[2 points]** If the original image is the first figure, and the resulting image after some processing is the second figure, what is the most likely processing to give this result?



Median filter (1) + edge detection (1)

2- **[2 points]** Consider the 3 images given below. The first image is the original image and the next two are processed images. Explain what type of filters has produced the effects in these two images.



Averaging (1)

edge detection (1)

3- **[2 points]** Given the following histogram distribution for an image (100 x 100) of a text page, determine the threshold value that you may select to segment the image into two regions, one for the text and another for the background. Assume that the text pixels occupies 50% of the entire image.

No. of pixels = 10000

Text pixels = 5000

T = 110

OR 100 if T // 100 text o.w background

Grey Level	Num of pixels
10	2000
30	1000
40	1000
80	600
100	400
120	500
180	600
200	1000
230	2000
250	900

4- **[3 points]** Consider the following histogram (2, 2, 4, 8, 16, 32, 64, 128), where the number of gray levels is 8. What is the output histogram of histogram equalization? Explain using the result how histogram equalization enhances the contrast of an image.

0	1	2	3	4	5	6	7
2	2	4	8	16	32	64	128

256 pixel

P(r)

$$T(r) = \text{round}\left((G-1) * \sum_{i=0}^{r} P(i)\right)$$

$T(0) = 7 * P(0) = \text{round}(7 * \frac{2}{256}) = 0$

$T(1) = \text{round}(7 * (P(0)+P(1))) = 0$

$T(2) = 0$

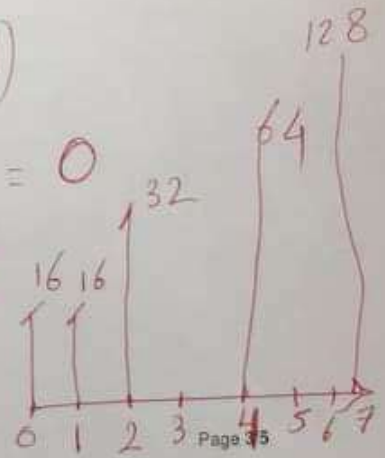
$T(3) = 0$

$T(4) = 1$

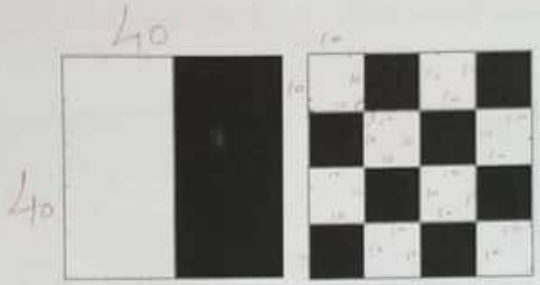
$T(5) = 2$

$T(6) = 4$

$T(7) = 7$



5- **[6 points]** The binary images shown below are quite different, but their histograms are the same. Suppose that each image is convolved with 3x3 averaging mask.

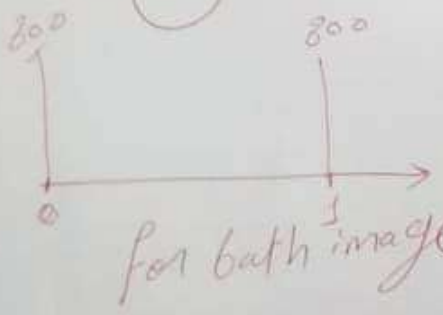


a. **(1 point)** Draw the histogram of the original images given that the size of the images is 40x40.

b. **(2 points)** Would the histograms of the new images after averaging still be equal? Explain

c. **(3 points)** If your answer is no, sketch the two histograms after averaging.

a- (1)



for both images.

b- NO in image 1

40 white Pixels will take value $\frac{6}{9} = \frac{2}{3}$

40 black Pixels will be $\frac{1}{3}$ (1)

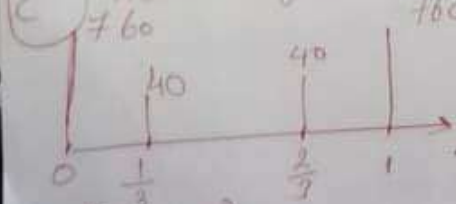
In image 2

200 white Pixel will be $\frac{2}{3}$

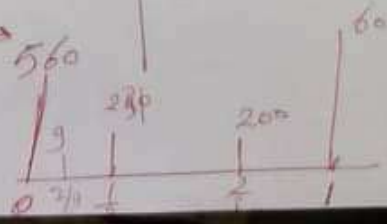
240 black Pixel will be $\frac{1}{5}$

(1)

c) new histo gram



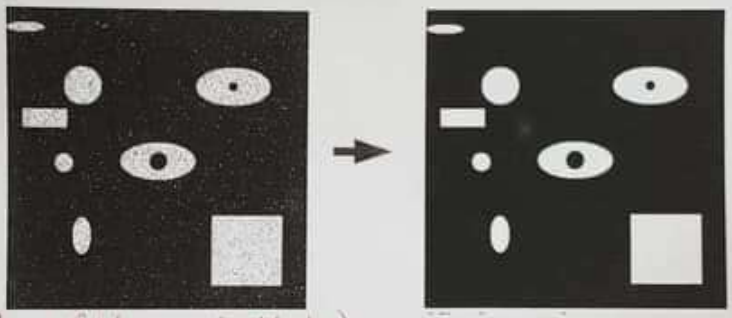
(image1)



(image2)

Question 3 (10 points):

1- **[5 points]** Given the left image below, which is corrupted with impulsive noise. State two different algorithms to remove correctly all the noise in the image to obtain a clean image like shown on the right.



① Median filter - (2 Marks)

② erosion one ~~flow~~ followed by 2 dilations (3 Marks)

2- **[5 points]** In the following figure, you can find a small image with 3 grey levels. Calculate the co-occurrence matrix for the image using the operator P ="one pixel right".

1	2	2	3	3
2	1	1	1	3
1	2	2	2	1
2	1	3	1	2
3	1	2	3	2

	1	2	3
1	2	~~3~~	2
2	3	3	2
3	2	1	1

Common Mistakes

Q2-1 we have to use only Median filter not other smoothing filters

Q2-3 all threshold values are correct 100, 110, 120
Most accurate
But you need to write the Comp. equation

T ≥ 120 back	T ≥ 100	background
T ≤ 100	T ≤ 100	object

Q2-5 you Assumed that it is 1 bit color only Although it didn't say that

Q3-1 Rotating Mask Can't work because Noise inside the objects will take a gray color not removed