

Quiz #3

IST number: _____

Name: _____

Duration: 20 minutes

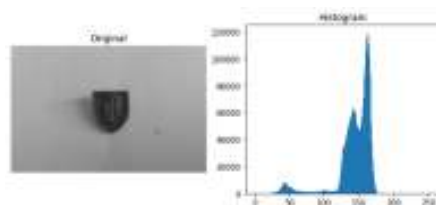
Provide clear, legible, and succinct answers.
Always justify your assumptions.

Questions

- Consider the set of pixels represented in the image, and assume as similarity criterion for pixels to be considered neighbours that their values belong to the subset $V = \{1, 3\}$.
Determine the shortest length of the (i) **4-**, (ii) **8-** and (iii) **m-**, paths between (p) and (q).

	0	1	1	2	1	(q)
	2	3	1	3	1	
	1	2	1	2	1	
	0	1	1	2	3	
(p)	1	0	2	2	1	

- Consider the following image and its histogram.
Suggest a set of image processing operations that could be used to enhance the image quality.
When possible, indicate values of relevant parameters of the proposed techniques.
Explain what aspects of the image quality will be improved, and why they will be improved.



- Specify a 3x3 filtering mask that could be used to detect vertical edges in an image.

- The image on the left was processed with the help of morphological operations, to get the result on the right. Explain what processing operations may have been applied.



- Consider an image of size 100 x 100 pixels, with each pixel taking values in: $\{0, 1, 2, 3\}$. The image histogram (x_k) is as specified in the table below.
 - Compute the new histogram after performing histogram equalization of the image ($s_k = T(x_k)$) and the values conversion table ($s_k(x_k)$).
 - Was a uniform distribution obtained? Why?
 - What would happen if applying the histogram equalization a second time?

r_k	n_k
0	3000
1	1000
2	2000
3	4000

r_k	s_k
0	
1	
2	
3	

s_k	n_k
0	
1	
2	
3	

Solutions

1

(i) there is no 4-connectivity between p and q

(ii) $l=4$ (diagonal)

(iii) $l=7$ (diagonal is only used when 4-connectivity is not available)

2

apply threshold at value 90 to clean background and the shadows, setting all pixels above the threshold to a relatively low value that is brighter than the (darker) region of interest – e.g., 120;

find connected components and keep only the background and the largest CC, to remove noise blobs;

apply contrast stretching or histogram equalization to improve the resulting image contrast

3

$[-1 \ 0 \ 1$

$-1 \ 0 \ 1$

$-1 \ 0 \ 1]$

4

Original – morphological erosion with 3x3 square structuring element

Alternative: morphological dilation – original

5

r_k	n_k	r_k	s_k	s_k	n_k
0	3000	0	1	0	0
1	1000	1	1	1	4000
2	2000	2	2	2	2000
3	4000	3	3	3	4000

a)

b) no – with discrete images it may not be possible to obtain a uniform histogram;

c) no change would result