



Exercise series 4
Computer vision basics course

Related teaching assistant: Mohammad Reza Elmi

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Delivery deadline: May 25

1. According to the given image, answer the following questions. (Consider 4-bit color levels).

A) Obtain the histogram of the image and the mean, median, mode, and variance of the brightness intensity. (5 points)

b) Run Otsu's algorithm for the threshold level {9.5, 11.5} and obtain a better threshold level. (10 points)









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

2. Answer the questions by reading the following text.

Gaussian Otsu's method is an extension of Otsu thresholding technique based on between class variance from the foreground and background regions. This approach is far faster than the optimal Otsu's method. This thresholding approach calculates the maximum between class variance in which uses the minimum within class variance. The between-class variance defines as following:

$$\begin{aligned}\sigma_B^2(t) &= \sigma^2 - \sigma_w^2(t) = \omega_b(t) * (\mu_b(t) - \mu)^2 + \omega_f(t) * (\mu_f(t) - \mu)^2 \\ &= \omega_b(t) * \omega_f(t) * (\mu_b(t) - \mu_f(t))^2\end{aligned}$$

Where σ^2 and μ are the total variance and the total mean of the image, respectively.

Original image	Histogram	thresholding value	
		Otsu	G.Otsu
 Walkbridge		0	124
 Woman dark hair		0	119
 Woman blonde		121	121
 Lena		116	116



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and accuracy. (10 points)

Otsu Gaussian Make a comparison in terms of speed _{and} A) Between Otsu

Is it equivalent to maximizing the variance between classes? Why?) 10 Y b) In Otsu's algorithm, minimizing the variance within the class

Score(

Read jpg.face and implement the segmentation algorithm that you read in class in the segment function 3. in the image file ipynb6.Q. (25 points)

4. A) Apply the wear and increase function on the desired image according to the structural element below. If needed, you can use padding reflect.

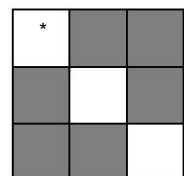
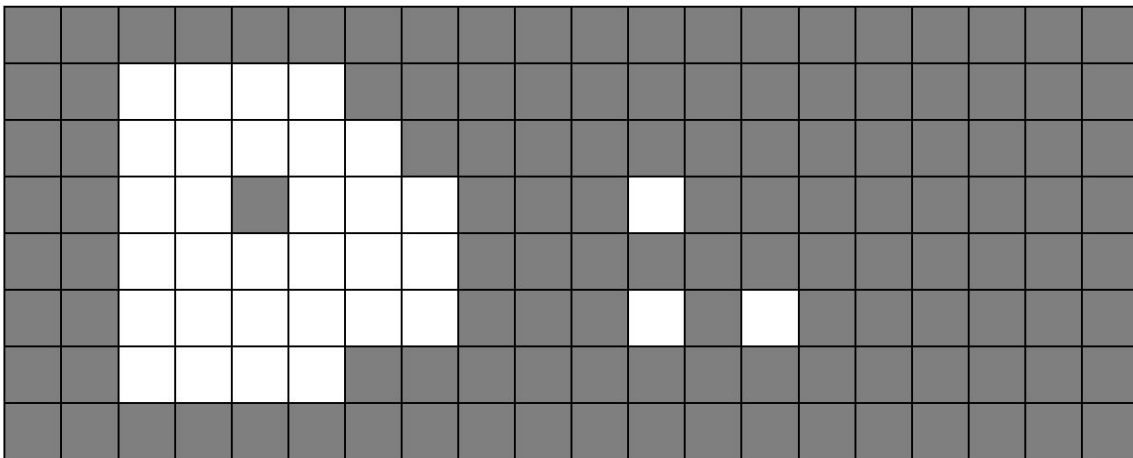
(Anchor location is in the center of the structural element.) (5 points)

1	1	1
1	0	0
0	0	0

60	70	60	60	70	60	60	60
60	70	70	70	70	70	70	60
60	70	60	70	70	70	70	70
80	60	80	60	70	80	70	70
60	70	70	60	70	60	60	60
60	70	80	60	80	70	60	60
70	60	80	60	60	80	60	60
60	70	70	80	60	80	60	70

b) Calculate the result of the open and closed operators for the shown image and structural element. The symbol * indicates the location of

the anchor in the structural element. (8 points)



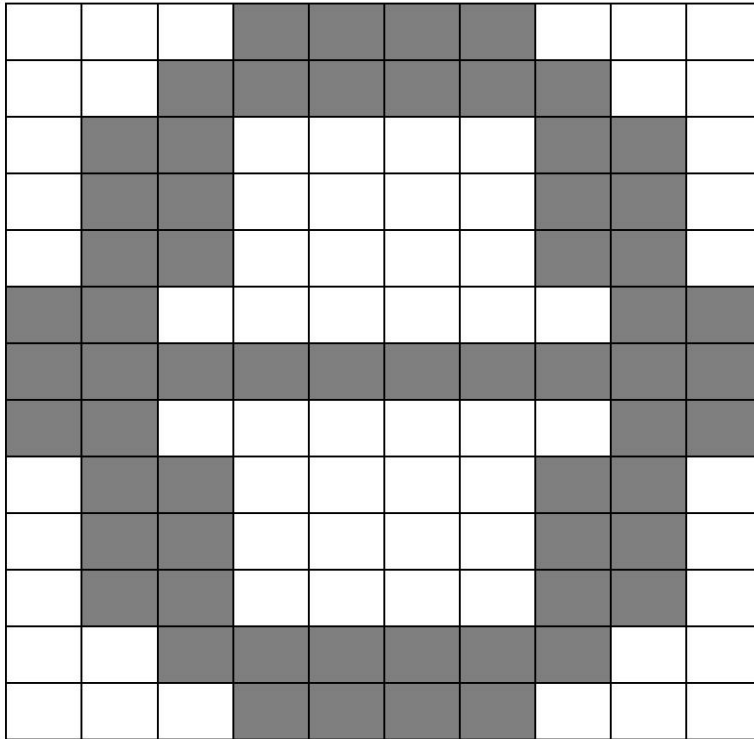


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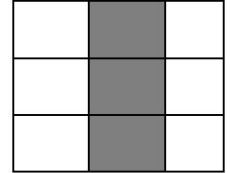
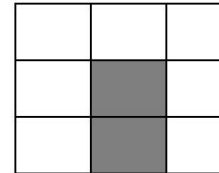
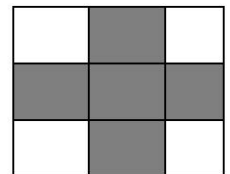
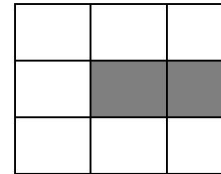
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5. A) Consider the opposite image. (5 points)

There are four structural elements as follows.



Using the above structural elements and choosing one

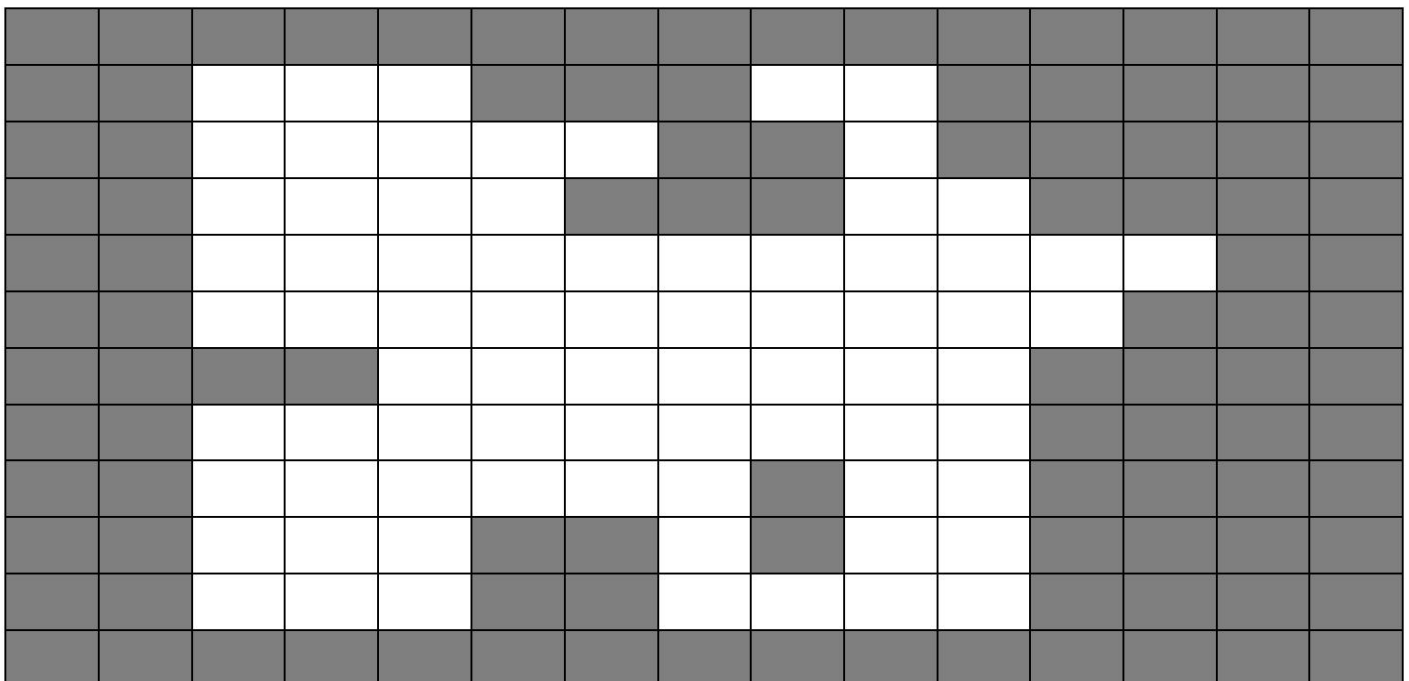
From the morphological operators, the above image in such a way

Change it so that the number zero remains in the image (remove the extra line in the middle of the image). The reason for your choices in each

Describe the step.

operator and suitable structural operators. (7 points)

b) Obtain the boundaries of the following image using the miss or hit





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expand, wear, open and close on the images in the images folder without using the ready functions of the 6. A) Apply the morphology operators libraries. (10 points)

b) This time, using ready-made functions, apply the same operators above on the image. (5 points)

(Points) Try to get the skeleton of the image using the operators you implemented in part A. (10 points)

13.5.2 image book and You can see the relationship of obtaining the image skeleton through morphological operators in section 13.5.1 vision machine and analysis, processing. You can download the book from this [link](#) use.

And follow the requirements. Please read the document on the rules of doing and delivering the exercises

Good luck.