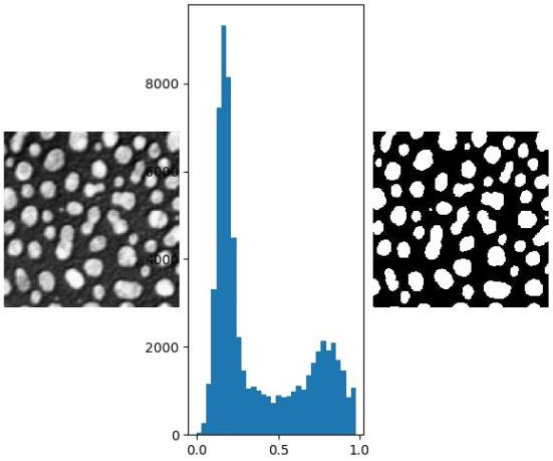
COMS30030 – Image Processing and Computer Vision

Problem Sheet MM04

Segmentation & Object Detection

1- How would you determine the best threshold to obtain the image on the right, given the image on the left and its histogram? What would be your guess at the best threshold.



Answer:

The easiest approach would be Adaptive Thresholding. A relatively good guess would be around 0.4. Another option can be the automatic Otsu Thresholding method if you would like to investigate it more (but it's not within the scope of this unit).

2- Which of the following is/are a stopping criteria for K-Means Clustering?

A. Centroids of the formed clusters do not change.
B. Points remain in the same cluster, even after multiple iterations.
C. When the maximum number of pre-specified iterations are reached.
D. A and B only.
E. A, B, and C.

Answer:

E

3- Which of the following is/are true about Region Split/Merge approach?

A. The results of split and merge tend to be *blocky* because quadtrees are used.
B. Regions are merged together if they satisfy a homogeneity condition.
C. An example homogeneity condition is if at least 85% of the pixels in R_i have the property $|z_j - m_i| > 2\sigma_i$ where z_j is the grey level of the j^{th} pixel in R_i , m_i is the mean grey level of the region and σ_i is the standard deviation of the grey levels in R_i
D. Always converges to a solution.
E. None of the above are true.

Answer:

A, B, and D. The answer in C would also be true if it stated $|z_j - m_i| < 2\sigma_i$

4- Use the *K*-means algorithm to help in clustering the pixels in image M (given below). The pixel values of M are shown in the image grid. In this example $K = 2$, the first mean, m_1, is initalised to 60 and the second mean, m_2, is initalised to 72. What are the values of m_1 and m_2 after one iteration of the *K*-means algorithm?

Image M

50	45	48
88	83	39
80	84	90

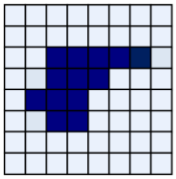
A. $m_1 = 44{:}0$ and $m_2 = 79{:}2$
B. $m_1 = 45{:}0$ and $m_2 = 84{:}0$
C. $m_1 = 48{:}0$ and $m_2 = 88{:}0$
D. $m_1 = 45{:}5$ and $m_2 = 85{:}0$
E. None of the above are correct

Answer:
D

5- Which of the following operations is typically used to remove small noise from a binary image?
A. Dilation
B. Opening
C. Closing
D. Gradient
E. Dilation & Opening

Answer:
B

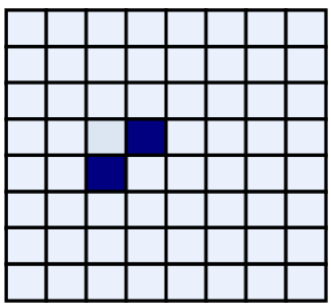
6- Apply an opening operation on the object shown below left using the structuring mask and plot the result.



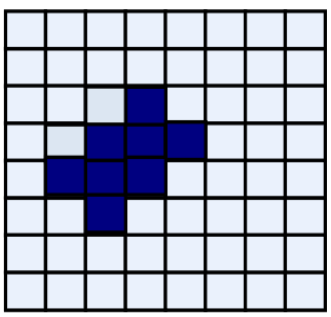
Structuring Element

Answer:

After Erosion operation:



After Dilation operation:



7- What is the role of AdaBoost in the Viola-Jones face detection algorithm?

A. It selects the most important features and combines them into a strong classifier
B. It weights incorrectly detected faces more heavily to focus on them in future scans
C. It improves the contrast of facial regions to enhance feature extraction
D. It reduces the size of the dataset by eliminating low-confidence predictions

Answer:
A

8- What is the primary purpose of Non-Maximum Suppression (NMS) in object detection algorithms?

A. To increase the number of detected objects
B. To improve the resolution of detected objects
C. To select the best bounding box by removing redundant ones
D. To smooth the edges of the detected objects

Answer:
C

9- How does the Viola-Jones algorithm detect faces at different scales in an image?

A. By using different classifiers for each face size
B. By resizing the input image
C. By adjusting the resolution of the classifier for each scan
D. By applying a single classifier with multi-scale filters for all face sizes
E. B and C

Answer:
B

10- The Image I's integral image is show below as II. However, the value at three locations are missing. What should those two values be?

I

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

II

4	5	7	9
4	9	12	17
7	13	16	25
9	16	22	33

A. 13, 17 and 21
B. 15, 17 and 22
C. 15, 17 and 21
D. 13, 17 and 22
E. 12, 15 and 22

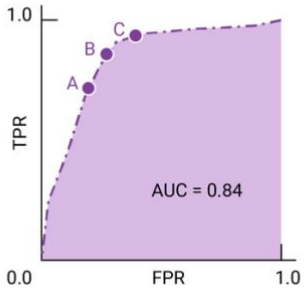
Answer:
D

11- In a Receiver Operating Characteristic (ROC) curve, what does the Area Under the Curve (AUC) represent, and what does it indicate about the performance of a classifier?

A. The probability that the classifier will rank a randomly chosen positive instance higher than a randomly chosen negative instance
B. The precision of the classifier at various threshold values
C. The percentage of correctly classified instances
D. The trade-off between precision and recall

Answer:
A. The probability that the classifier will rank a randomly chosen positive instance higher than a randomly chosen negative instance

12- Imagine a situation where it's better to allow some spam to reach the inbox than to send a business-critical email to the spam folder. You've trained a spam classifier for this situation where the positive class is spam and the negative class is not-spam. Which of the following points on the ROC curve for your classifier is preferable?



A. A
B. B
C. C
D. None of the above

Answer:
Point A is the correct answer as it's better to minimize false positives, even if true positives also decrease. Point B threshold balances true and false positives. Point C threshold increases true positives (flags more spam) at a cost of more false positives (more legitimate emails flagged as spam).

13- A model outputs 3 TP, 4 TN, 2 FP, and 1 FN. Calculate the precision.

A. 5/6
B. 0.6
C. 0.85
D. 7/10
E. None of the above

Answer:

Precision is calculated as {TP}/{TP+FP}=3/5=0.6 or 60%. For more practice, calculate the recall, accuracy, F1 score etc. too.