

Concordia University

Department of Computer Science & Software Engineering

COMP 478/6771 Image Processing

Assignment 4 - Due Date: *Dec 2, 2024*

Part I: Theoretical questions

1. **(8 points)** In Otsu's method for thresholding in Chapter 10 of the textbook (Page 749). We have the following equations:

$$P_1 m_1 + P_2 m_2 = m_G$$

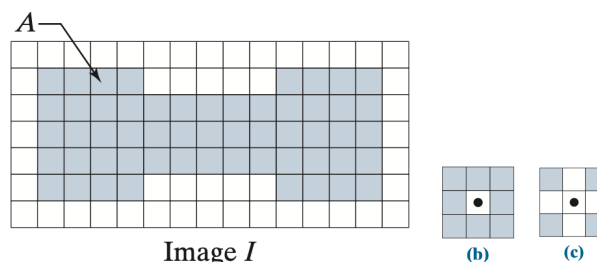
$$P_1 + P_2 = 1$$

$$\sigma_B^2 = P_1(m_1 - m_G)^2 + P_2(m_2 - m_G)^2$$

Use these to derive the following term: $\sigma_B^2 = P_1 P_2 (m_1 - m_2)^2$

You must give details of your derivations.

2. **(6 points)** Please use the following structuring element b and c to erode Image I. Please illustrate your result. To deal with the border effect, we pad the regions outside the image I with '1's'.



Part II: Programming questions

1. **(20 points)** Download the image (noisycoin.png) from the course webpage. For this image, we would like to write a script to automatically segment the image, count the number of coins in the image, and obtain the coordinates and radii of the coins.

a) **(7 points)** Implement and apply Otsu's algorithm to the image to segment the coins and

show the result.

b) (5 points) Smooth the image by a 3x3 averaging filter, then apply Otsu's algorithm and show the result. Compare the results in a) and b).

c) (3 points) Use the function *imsegkmeans()* in MATLAB (a similar function *segmentation.slic()* exists in scikit-image) to segment coins from the original and denoised images (in part b) using the k-mean algorithm. Show the results.

d) (5 points) In class, we mentioned the use of Hough Transform to detect circles in an image. By using the *imfindcircles()* function (radius range of [20 50]) in MATLAB to find the centroid coordinates and radii of all the coins in the image, by applying this function on the segmentation results of the denoised image from Part c. Please use *viscircles()* to visualize the circles detected in the segmented image. Note that in scikit-image, a similar function *transform.hough_circle()* is available.