Concordia University

Department of Computer Science & Software Engineering

COMP 478/6771 Image Processing

Assignment 4 - Due Date: *Dec 6, 2022*

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:

   $P_1 m_1 + P_2 m_2 = m_G$

   $P_1 + P_2 = 1$

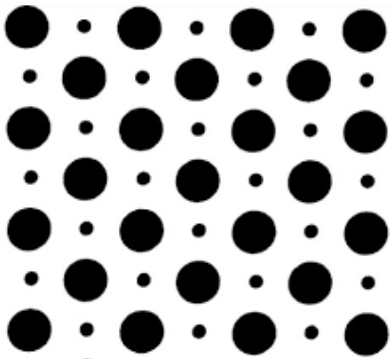
   $\sigma_B^2 = P_1(m_1 - m_G)^2 + P_2(m_2 - m_G)^2$

   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. (**8 points)** Explain why Hough transform for lines cannot be carried out in the Cartesian (x, y) coordinate system. Give details on how Hough transform for line searching is done on a set of *n* points.

3. (**8 points)** Here is a binary image of polka dots of two different sizes. Assume that the sizes of the dots are known, can you devise an algorithm using the knowledge you have learnt to obtain the number of the bigger dots automatically?



Part II: Programming questions (26 points)

1. (**10 points**) Download the image (tools_noisy.png) from the course webpage. This image contains noise.

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

2. Download the image *lena.tif* from the course webpage, then do the following with the MATLAB function, *wavedec2()*:

   a) (**5 points**) Perform wavelet transform of the Lena image up to and including level 3 by using Haar wavelet, and show your results.
   b) (**5 points**) Perform wavelet transform of the Lena image up to and including level 3 by using Daubechies-4 wavelet (check out the 'wname' flag for available wavelets), and show your results.
   c) (**6 points**) Visually compare the quality of the *approximation images* at level 3 of the two cases and give your comments.