Concordia University

Department of Computer Science & Software Engineering
COMP 478/6771 Image Processing
Assignment 4 - Due Date: *Dec 5, 2023*

Part I: Theoretical questions

1. (a) (**4 points**) What is the limiting effect (or the ultimate result) of repeatedly dilating or eroding an image? Assume that a trivial (one point) structuring element is not used.

    (b) (**4 points**) What is that smallest image from which you can start in order for your answer in part (a) to hold?

    Note: Answer the above questions separately for dilation and erosion.

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 squares of two different sizes. Assume that the sizes of the squares are known, can you devise an algorithm using the knowledge you have learnt to obtain the number of the bigger squares automatically?
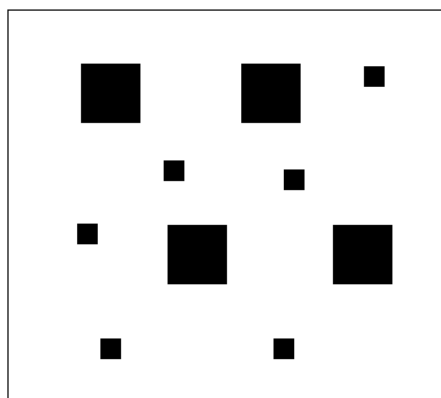
Part II: Programming questions (26 points)

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

   a) (**5 points**) Implement and 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 (*if you are able to find any Python library for wavelet processing, please feel free to use it*), *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.