Concordia University
Department of Computer Science & Software Engineering

COMP 478/6771 Image Processing
Assignment 2
Due Date: October 16, 2017

1. In character recognition, text pages are reduced to binary form then followed by a thinning process that will reduce the characters to strings of binary 1s on a background of 0s. Due to noise the binarization and thinning processes could result in broken strings of 1s with gaps ranging from 1 to 5 pixels. The aim is to repair it so that there are no gaps in the strings of 1s. This is done as follows:
   a) Blur the binary image by an averaging filter then apply a thresholding method to convert it back to binary form. For this approach give the minimum size of the blurring mask and the minimum value of the threshold to accomplish the task.
   b) Without using the averaging filter and thresholding, can you design another method to repair the gaps?

2. Download the gray level image from the website then carry out the following algorithm to estimate the threshold T. Use the threshold T to binarize the image and show your results.

Input: A grayscale image
Output: A threshold value T
Procedure:
MAXIMUM=0; T=0;
for each t =0, $t < L$, t ++

$$P(t) = \sum_{i=0}^{t} p_i;$$

$$H(S) = H_b + H_w = -\sum_{i=0}^{t} \frac{p_i}{P(t)} \log\left(\frac{p_i}{P(t)}\right) - \sum_{i=t+1}^{L-1} \frac{p_i}{1-P(t)} \log\left(\frac{p_i}{1-P(t)}\right);$$

if $H(S)$ > MAXIMUM then
MAXIMUM=$H(S)$; T=t;
end if
end for

3. Fourier Transform:
   a) Study Example 4.1 on page 206 of the textbook, then follow the steps in that example to find the Fourier Transform of the function $f(t) = A$ for $0 \le t \le W$ and $f(t) = 0$ otherwise; where both A and W are constants. Explain the differences between your result and the result in Example 4.1. Consisder the case where $A = W = 1$, what is the Fourier Transform of $f(t)$ in this case?

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b) Use the result of Example 4.1 to find the Fourier Transform of the tent function. The tent function is the function shown in Figure 4.6(a) on page 214 of the Text. Note that the tent function is the convolution of two box functions shown in Fig. 4.4(a).

4. Given a 3 by 3 spatial mask that averages the four closest neighbours of a point (x, y) but excludes the point itself from the average. Find the equivalent filter $H(u,v)$ in the frequency domain.