ANKARA UNIVERSITY
Computer Engineering
466 – Digital Image Processing
Final Examination

31.5.2020

1. [10 points] Assume that we have a monochrome digital image in which intensities range between 0 and L-1. A and B (A<B) are 2 intensities in this range. We want to negate the intensities except those in between A and B. Intensities between A and B should become black (0). Plot the shape of the function to achieve this effect.

2. [35 points] The table below represents a 6x6 monochrome digital image with 4 bits per pixel.

3	3	4	4	4	4
4	4	3	6	7	5
4	4	4	7	9	7
4	4	4	8	10	7
4	5	4	7	8	6
4	5	4	5	5	4

   a. [10 points] Show the histogram for this image.
   b. [15 points] Apply histogram equalization to the image. Show your steps, resulting histogram, and the new image.
   c. [10 points] Apply the weighted averaging filter given below to your result from part (b). If you did not answer (b) apply it to the original image above. Specify how you handled the missing pixels at the edges. You can choose any of the options described in the course.

1/16	2/16	1/16
2/16	4/16	2/16
1/16	2/16	1/16

3. [18 points] The image A below is a 15 x 15 binary image. White pixels should be considered as 1 and black pixels as 0. Sketch the result of the morphological operation $(A \ominus M1) \oplus M2$.

Image A: 

M1		
	1	
1	1	1
	1	

M2		
	1	
	1	
	1	

4. [10 points] Consider the image given in the previous question as a MxN filter for a frequency domain filtering operation. In other words, we have the Fourier transform of a MxN image and we apply the plus shape filter you see above. What will be the effect of this operation on the image?

5. [27 points] Consider the image on the right composed of solid color squares. For discussing your answer, choose a gray scale consisting of eight shades of gray, 0 through 7, where 0 is black and 7 is white. Suppose that the image is converted to HSI color space. In answering the following questions, use specific numbers for the pixels' values.
    a. [9 points] Sketch the hue image.
    b. [9 points] Sketch the saturation image.
    c. [9 points] Sketch the intensity image.