

**Student ID:**

**Question 1 (15 marks)**

The following figure shows (a) a 3-bit image of size 5-by-5 image in the square, with x and y coordinates specified, (b) a Laplacian filter.

y \ x	0	1	2	3	4	
0	3	7	6	2	0	Laplacian filter
1	2	2	6	0	1	
2	4	5	2	7	4	
3	3	1	6	5	1	
4	2	7	5	1	4	
						1 1 1
						1 -8 1
						1 1 1

(a)

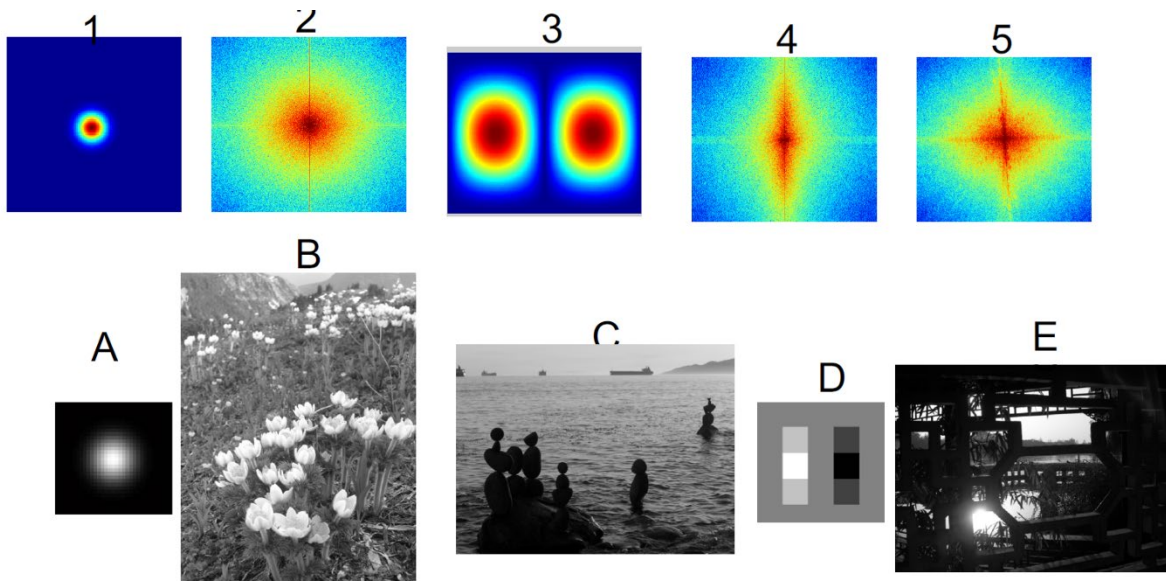
(b)

Compute the following:

- The output of a  $3 \times 3$  average smoothing filter at (3,3).
- The output of a  $3 \times 3$  median filter at (2,3).
- The output of the  $3 \times 3$  Laplacian filter shown above at (1,3).
- Obtain the histogram of the image.
- Apply histogram equalization on the above image and calculate the histogram equalized image, and the new histograms.

**Question 2 (15 marks)**

Please match following images A-E with the corresponding Fourier spectrum 1-5? Explain the reasons.



**Question 3 (10 marks)**

Suppose that you form a lowpass spatial filter that average the four immediate neighbors of a point  $(x,y)$ , but excludes the point itself.

- (a) Find the equivalent filter  $H(u,v)$  in the frequency domain.
- (b) Show that your result is a lowpass filter.

**Question 4 (10 marks)**

For given image “skeleton\_orig.tif” in the canvas folder of 202202EE4211/Files/Lecture 2\_Image enhancement in spatial domain/code, please utilize spatial enhancement methods, including both point processing and neighbourhood processing, to enhance the images. Please copy your codes here for the task, and put the original image and the enhanced one here. You can also upload the codes for checking.