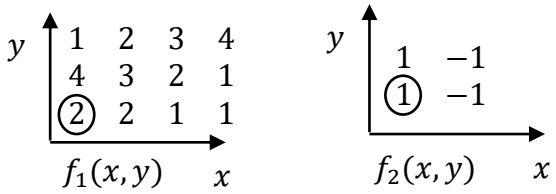
NTUT112-1 Digital Image Processing
Homework Assignment 2
Due Date: 10/30(Mon.) 2023

Question 1:

Calculating the results of the following convolution of $f_1(x,y) * f_2(x,y)$ and correlation of $f_1(x,y) \circ f_2(x,y)$. Draw the results in the X-Y plot with the coordinates of origin (0,0).

(Circular notation represents the origin (0,0).)



Question 2:

This is an image with grey levels between 0 to 15 (4-bit image), please perform Histogram Equalization procedures to the following image and show the corresponding new image.

1	2	3	3	3	3	3	3
1	2	3	10	10	5	5	6
1	2	3	10	11	5	5	6
1	2	3	11	12	5	8	9
2	2	3	11	12	7	8	9
2	2	3	11	12	7	8	6
2	2	4	5	5	7	6	6
2	2	4	5	5	7	6	6

Question 3:

Write m-files with mask size of 5x5 for the following image enhancement functions (only for 8-bit grey level images). O: OutImage ; I:InputImage;

(a) A noise removing filter for salt-and-pepper noise degraded images:

O = medianfilter(I, filter_size)

(b) A Gaussian filter for removing noise:

O = gaussfilter(I, K, filter_size, sigma)

(c) A high-boost sharpening filter for image enhancement:

O = highboostfilter (I, A, filter_size)

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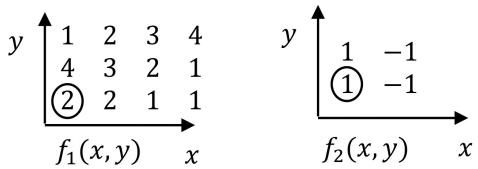
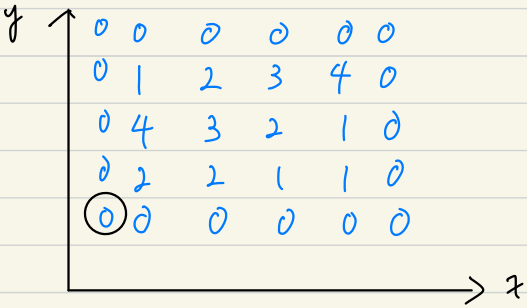
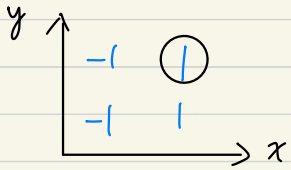


Padded $f_1(x,y)$



rotation kernel of 180°



Convolution

$0\times(-1)+0\times1+0\times-1+2\times1=2$

0 0 2 2 = 0

0 0 2 1 = −1

0 0 1 1 = 0

0 0 1 0 = −1

$0\times(-1)+2\times1+0\times(-1)+4\times1=6$

2 2 4 3 = −1

2 1 3 2 = −2

$1 \times (-1) + 1 \times 1 + 2 \times (-1) + 1 \times 1 = -1$

$1 \times (-1) + 0 \times 1 + 1 \times (-1) + 0 \times 1 = -2$

$0 \times (-1) + 4 \times 1 + 0 \times (-1) + 1 \times 1 = 5$

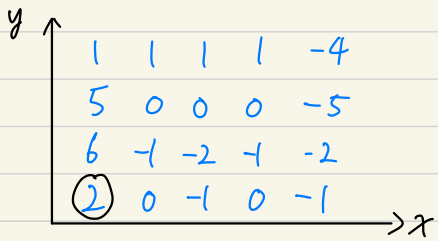
$4 \times (-1) + 3 \times 1 + 1 \times (-1) + 2 \times 1 = 0$

3	2	2	3	$= 0$
2	1	3	4	$= 0$
1	0	4	0	$= -5$

$0 \times (-1) + 1 \times 1 + 0 \times (-1) + 0 \times 1 = 1$

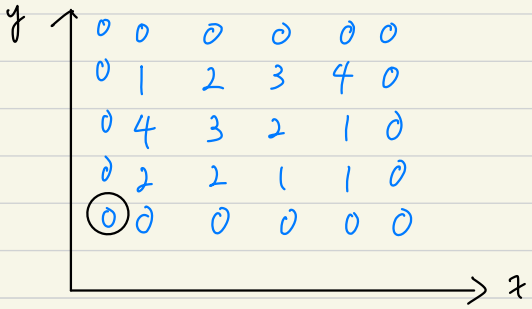
1	2	0	0	$= 1$
2	3	0	0	$= 1$
3	4	0	0	$= 1$
4	0	0	0	$= -4$

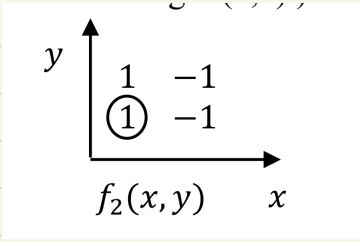
Result



Correlation

Padded $f_1(x, y)$





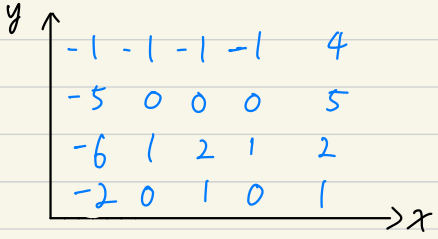
$0 \times 1 + 0 \times (-1) + 0 \times 1 + 2 \times (-1) = -2$

0	0	2	2	= 0
0	0	2	1	= 1
0	0	1	1	= 0
0	0	1	0	= 1

$0 \times 1 + 2 \times (-1) + 0 \times 1 + 4 \times (-1) = -6$

$2 \quad 2 \quad 4 \quad 3 \quad = 1$

Result



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2	2	4	5	5	7	6	6

<Sol>

Step 1 : Choose the L

因為給定的Image 最大是 12，所以用 4-bit 去裝 ($2^4=16$)

所以 L = 15

Step 2 : Summerize the frequency of each numbers

Gray-level	0	1	2	3	4	5	6	7	8	9	10
freq	0	4	12	11	2	9	7	4	3	2	3

Gray Scale	11	12	13	14	15
freq	4	3	0	0	0

Gray Scale	Freq	PDF	CDF	S_k	$S_k \times 15$	Histogram Equalization
0	0	0	0	0		
1	4	0.0625	0.0625	0.9375		1
2	12	0.1875	0.25	3.75		4
3	11	0.171875	0.421875	6.328125		6
4	2	0.03125	0.453125	6.796875		7
5	9	0.140625	0.59375	8.90625		9
6	7	0.109375	0.703125	10.546875		11
7	4	0.0625	0.765625	11.484375		11
8	3	0.046875	0.8125	12.1875		12
9	2	0.03125	0.84375	12.65625		13
10	3	0.046875	0.890625	13.359375		13
11	4	0.0625	0.953125	14.296875		14
12	3	0.046875	1	15		15
13	0	0	0			
14	0	0	0			
15	0	0	0			
	$n=64$					

Ans :

1	4	6	6	6	6	6	6
1	4	6	13	13	9	9	11
1	4	6	13	14	9	9	11
1	4	6	14	15	9	12	13
4	4	6	14	15	11	12	13
4	4	6	14	15	11	12	11
4	4	7	9	9	11	11	11
4	4	7	9	9	11	11	11