COMPUTER VISION

HOMEWORK 1

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COLLOBORATED FOR EDGE DETECTION WITH PRAVEEN PICHAI

Question 2

J1 =

Columns 1 through 8

0.0163	0.0788	0.2263	0.3950	0.4825	0.4925	0.4750	0.4313
0.0788	0.1800	0.3275	0.4375	0.4688	0.4387	0.3775	0.2962
0.2262	0.3275	0.4238	0.4463	0.4100	0.3287	0.2188	0.1250
0.3937	0.4313	0.4363	0.4175	0.4075	0.3325	0.1837	0.0713
0.4688	0.4275	0.3537	0.3762	0.5213	0.5563	0.4125	0.2462
0.4212	0.3212	0.2100	0.2725	0.5337	0.7338	0.7275	0.5900
0.2737	0.1712	0.0800	0.1238	0.3438	0.6400	0.8425	0.8625
0.1213	0.0625	0.0175	0.0313	0.1575	0.4525	0.7875	0.9525

Columns 9 through 10

0.3700	0.3325
0.2100	0.1600
0.0625	0.0313
0.0225	0.0038
0.1250	0.0625
0.4200	0.3200
0.7750	0.7125
0.9650	0.9525

J2 =

Columns 1 through 8

0.0163	0.0788	0.2263	0.3950	0.4825	0.4925	0.4750	0.4312
0.0788	0.1800	0.3275	0.4375	0.4687	0.4387	0.3775	0.2962
0.2263	0.3275	0.4237	0.4462	0.4100	0.3287	0.2188	0.1250
0.3937	0.4312	0.4362	0.4175	0.4075	0.3325	0.1838	0.0713
0.4687	0.4275	0.3538	0.3763	0.5212	0.5562	0.4125	0.2463
0.4212	0.3212	0.2100	0.2725	0.5337	0.7337	0.7275	0.5900
0.2738	0.1713	0.0800	0.1238	0.3438	0.6400	0.8425	0.8625
0.1213	0.0625	0.0175	0.0313	0.1575	0.4525	0.7875	0.9525

Columns 9 through 10

0.3700	0.3325
0.2100	0.1600
0.0625	0.0313
0.0225	0.0038
0.1250	0.0625
0.4200	0.3200
0.7750	0.7125
0.9650	0.9525

Verified J1=J2

1) $I = \begin{bmatrix} 0 & 0 & 0 & 0.5 & 0.5 & 0.5 & 0.5 & 0.5 & 0.5 & 0.5 \\ 0 & 0 & 0.5 & 0.5 & 0.5 & 0.5 & 0.5 & 0.5 & 0 & 0 \\ 0 & 0.5 & 0.5 & 0.5 & 0.5 & 0.5 & 0 & 0 & 0 & 0 \\ 0.5 & 0.5 & 0.5 & 0.5 & 0 & 0 & 0 & 0 & 0 & 0 \\ 0.5 & 0.5 & 0.5 & 0 & 1 & 1 & 0 & 0 & 0 & 0 \\ 0.5 & 0.5 & 0 & 0 & 1 & 1 & 1 & 1 & 0 & 0 \\ 0.5 & 0 & 0 & 0 & 0 & 1 & 1 & 1 & 1 & 1 \\ 0 & 0 & 0 & 0 & 0 & 0 & 1 & 1 & 1 & 1 \end{bmatrix}$

$G_x = \begin{bmatrix} 0.05 & 0.25 & 0.4 & 0.25 & 0.05 \end{bmatrix}$

$G_y = \begin{bmatrix} 0.05 \\ 0.25 \\ 0.4 \\ 0.25 \\ 0.05 \end{bmatrix}$

$I_{in}(1,1)$

0	0	0	0	0	0
0.05	0.25	0.4	0.25	0.05	

$G(-k)$

$I_{out}(1,1)$
0

$I_{in}(1,2)$

0	0	0	0	0	0.5
0.05	0.25	0.4	0.25	0.05	

$G(-k)$

0.025
$I_{out}(1,2)$

and so on.

Similarly for vertical direction convolution.

$I \circledast G_y$

	$G_y(-k)$	
0		$I \circledast G_y(1,1)$
0	0.05	
0	0.25	
0	0.4	$\longrightarrow$ 0
0	0.25	
0	0.05	

$I \circledast G_y$

0		
0	0.05	$I \times G_y(2,1)$
0	0.25	
0	0.4	$\longrightarrow$ 0.025
0	0.25	
0.5	0.05	

Generally convolving a vector of size m with another vector of size n will give output of size $m+n-1$.

Here after the output is computed it is truncated to the image size I.

Each pixel requires 5 multiplications & 4 addition for convolving with G_x.

No. of pixels in $I = 8 \times 10 = 80$

No. of multiplications for $I \circledast G_x = 80 \times 5 = 400$

No. of additions for $I \circledast G_x = 80 \times 4 = 320$

For J1 No. of mults = 400 + 400 = 800

since convolve first in x and they in y direction

No. of additions = 320 + 320 = 640

Note: This if the o/p shud be of same size as i/p.

For J2

$G_x \circledast G_y$ = 5×5 matrix

It involves = 25 multiplications

Each element with every element of the other

Now each time this 5×5 matrix has to be multiplied centred around pixel of interest

No. of mults = 25 × 80 = 2000

No. of additions = 24 × 80 = 1920

Total mults = 2025

Total additions = 1920.

Question 3

Ix =

Columns 1 through 8

0.0625	0.1475	0.1687	0.0875	0.0100	-0.0175	-0.0438	-0.0612
0.1013	0.1475	0.1100	0.0313	-0.0300	-0.0612	-0.0812	-0.0862
0.1012	0.0963	0.0225	-0.0363	-0.0812	-0.1100	-0.0938	-0.0625
0.0375	0.0050	-0.0187	-0.0100	-0.0750	-0.1487	-0.1125	-0.0488
-0.0413	-0.0737	0.0225	0.1450	0.0350	-0.1437	-0.1663	-0.1213
-0.1000	-0.1112	0.0625	0.2612	0.2000	-0.0062	-0.1375	-0.1700
-0.1025	-0.0913	0.0437	0.2200	0.2962	0.2025	0.0200	-0.0875
-0.0588	-0.0450	0.0137	0.1263	0.2950	0.3350	0.1650	0.0125

Columns 9 through 10

-0.0375	-0.3325
-0.0500	-0.1600
-0.0312	-0.0313
-0.0188	-0.0038
-0.0625	-0.0625
-0.1000	-0.3200
-0.0625	-0.7125
-0.0125	-0.9525

Iy =

Columns 1 through 8

0.0625	0.1013	0.1012	0.0425	-0.0137	-0.0538	-0.0975	-0.1350
0.1475	0.1475	0.0963	0.0088	-0.0587	-0.1100	-0.1587	-0.1712
0.1675	0.1038	0.0125	-0.0287	-0.0025	0.0038	-0.0350	-0.0537
0.0750	-0.0038	-0.0825	-0.0412	0.1137	0.2237	0.2288	0.1750
-0.0475	-0.1062	-0.1437	-0.1038	0.0125	0.1775	0.3150	0.3437
-0.1475	-0.1500	-0.1300	-0.1488	-0.1900	-0.0938	0.1150	0.2725
-0.1525	-0.1088	-0.0625	-0.0925	-0.1863	-0.1875	-0.0550	0.0900
-0.1213	-0.0625	-0.0175	-0.0313	-0.1575	-0.4525	-0.7875	-0.9525

Columns 9 through 10

-0.1600	-0.1725
-0.1475	-0.1288
-0.0400	-0.0275
0.1025	0.0588
0.2950	0.2575
0.3550	0.3925
0.1900	0.2400
-0.9650	-0.9525

Magnitude of image gradient

Ig =

Columns 1 through 8

0.0078	0.0320	0.0387	0.0095	0.0003	0.0032	0.0114	0.0220
0.0320	0.0435	0.0214	0.0011	0.0044	0.0159	0.0318	0.0368
0.0383	0.0200	0.0007	0.0021	0.0066	0.0121	0.0100	0.0068
0.0070	0.0000	0.0072	0.0018	0.0186	0.0722	0.0650	0.0330
0.0040	0.0167	0.0212	0.0318	0.0014	0.0522	0.1269	0.1329
0.0318	0.0349	0.0208	0.0904	0.0761	0.0088	0.0321	0.1032
0.0338	0.0202	0.0058	0.0570	0.1225	0.0762	0.0034	0.0158
0.0182	0.0059	0.0005	0.0169	0.1118	0.3170	0.6474	0.9074

Columns 9 through 10

0.0270	0.1403
0.0243	0.0422
0.0026	0.0017
0.0109	0.0035
0.0909	0.0702
0.1360	0.2565
0.0400	0.5653
0.9314	1.8145