Sobel filter example

- Compute Gx and Gy, gradients of the image performing the convolution of Sobel kernels with the image
- Use zero-padding to extend the image

0	0	10	10	10
0	0	10	10	10
0	0	10	10	10
0	0	10	10	10
0	0	10	10	10

y

x

1	0	-1
2	0	-2
1	0	-1

h_x

-1	-2	-1
0	0	0
1	2	1

h_y

G_x

0	30	30	0	-30
0	40	40	0	-40
0	40	40	0	-40
0	40	40	0	-40
0	30	30	0	-30

G_y

0	-10	-30	-40	-30
0	0	0	0	0
0	0	0	0	0
0	0	0	0	0
0	10	30	40	30

Sobel filter example

- Compute Gx and Gy, gradients of the image performing the convolution of Sobel kernels with the image
- Use border values to extend the image

0	0	10	10	10
0	0	10	10	10
0	0	10	10	10
0	0	10	10	10
0	0	10	10	10

y

x

1	0	-1
2	0	-2
1	0	-1

h_x

-1	-2	-1
0	0	0
1	2	1

h_y

G_x

0	40	40	0	0
0	40	40	0	0
0	40	40	0	0
0	40	40	0	0
0	40	40	0	0

G_y

0	0	0	0	0
0	0	0	0	0
0	0	0	0	0
0	0	0	0	0
0	0	0	0	0

$$\Theta = \arctan\left(\frac{G_y}{G_x}\right)$$

	0	0		
	0	0		
	0	0		
	0	0		
	0	0		

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0	0	0	0	0
0	0	0	0	0
10	10	10	10	10
10	10	10	10	10
10	10	10	10	10

y

x

G_x

0	0	0	0	0
0	0	0	0	0
0	0	0	0	0
0	0	0	0	0
0	0	0	0	0

G_y

0	0	0	0	0
-40	-40	-40	-40	-40
-40	-40	-40	-40	-40
0	0	0	0	0
0	0	0	0	0

1	0	-1
2	0	-2
1	0	-1

h_x

-1	-2	-1
0	0	0
1	2	1

h_y

$$\Theta = \arctan\left(\frac{G_y}{G_x}\right)$$

-π/2	-π/2	-π/2	-π/2	-π/2
-π/2	-π/2	-π/2	-π/2	-π/2

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0	0	0	0	10
0	0	0	10	10
0	0	10	10	10
0	10	10	10	10
10	10	10	10	10

y

x

G_x

0	0	10	40	30
0	10	30	30	10
10	30	30	10	0
20	30	10	0	0
10	10	0	0	0

G_y

0	0	-10	-20	-10
0	-10	-30	-30	-10
-10	-30	-30	-10	0
-40	-30	-10	0	0
-30	-10	0	0	0

1	0	-1
2	0	-2
1	0	-1

h_x

-1	-2	-1
0	0	0
1	2	1

h_y

$$\Theta = \arctan\left(\frac{G_y}{G_x}\right)$$

		-π/4	-0.15π	-0.10π
	-π/4	-π/4	-π/4	-π/4
-π/4	-π/4	-π/4	-π/4	
-0.35π	-π/4	-π/4		
-0.40π	-π/4			

Laplacian example

- Compute the convolution of image I with the Laplacian kernel
- Use border values to extend the image

y

0	0	0	0	10
0	0	0	10	10
0	0	10	10	10
0	10	10	10	10
10	10	10	10	10

x

I

1	1	1
1	-8	1
1	1	1

Laplacian

y

0	0	10	40	-20
0	10	30	-30	-10
10	30	-30	-10	0
40	-30	10	0	0
-20	-10	0	0	0

x

Laplacian*I

Erosion example

- Erode the image below using kernels S1 and S2
- Use border values to extend the image

y

0	0	0	0	1
0	0	0	1	1
0	0	1	1	1
0	1	0	0	1
1	1	1	1	1

x

1	1	1
1	1	1
1	1	1

S_1

0	1	0
1	1	1
0	1	0

S_2

$f \ominus S1$

0	0	0	0	0
0	0	0	0	0
0	0	0	0	0
0	0	0	0	0
0	0	0	0	0

$f \ominus S2$

0	0	0	0	0
0	0	0	0	1
0	0	0	0	1
0	0	0	0	0
0	1	0	0	1

Dilation example

- Erode the image below using kernels S1 and S2
- Use border values to extend the image

0	0	0	0	1
0	0	0	1	1
0	0	1	1	1
0	1	0	0	1
1	1	1	1	1

y

x

1	1	1
1	1	1
1	1	1

S_1

0	1	0
1	1	1
0	1	0

S_2

$f \oplus S1$

0	0	1	1	1
0	1	1	1	1
1	1	1	1	1
1	1	1	1	1
1	1	1	1	1

$f \oplus S2$

0	0	0	1	1
0	0	1	1	1
0	1	1	1	1
1	1	1	1	1
1	1	1	1	1

Dilation-Erosion example

- Dilate then erode the image below using kernels S2
- Use border values to extend the image

0	0	0	0	1
0	0	0	1	1
0	0	1	1	1
0	1	0	0	1
1	1	1	1	1

y

x

0	1	0
1	1	1
0	1	0

S_2

$f \oplus S2$

0	0	0	1	1
0	0	1	1	1
0	1	1	1	1
1	1	1	1	1
1	1	1	1	1

$(f \oplus S2) \ominus S2$

0	0	0	0	1
0	0	0	1	1
0	0	1	1	1
0	1	1	1	1
1	1	1	1	1