Report

(a) Robert's Operator

For pixel (r, c), calculate r_1, r_2

$$r_1 = I(r+1, c+1) - I(r, c), r_2 = I(r+1, c) - I(r, c+1)$$

gradient magnitude: $\sqrt{r_1^2 + r_2^2}$

If gradient magnitude >= 12, output(r, c) = 0, else 255.

(b) Prewitt's Edge Detector

For pixel (r, c), calculate p_1, p_2 by the following mask, (r, c) corresponds to the center of the mask.

-1	-1	-1
1	1	1

p_1

-1		1
-1		1
-1		1

p_2

gradient magnitude: $\sqrt{p_1^2 + p_2^2}$

If gradient magnitude >= 24, output(r, c) = 0, else 255.

(c) Sobel's Edge Detector

For pixel (r, c), calculate s_1, s_2 by the following mask, (r, c) corresponds to the center of the mask.

-1	-2	-1
1	2	1

s_1

-1		1
-2		2
-1		1

s_2

gradient magnitude: $\sqrt{s_1^2 + s_2^2}$

If gradient magnitude >= 38, output(r, c) = 0, else 255.

(d) Frei and Chen's Gradient Operator

For pixel (r, c), calculate f_1, f_2 by the following mask, (r, c) corresponds to the center of the mask.

-1	$-\sqrt{2}$	-1
1	$\sqrt{2}$	1

f_1

-1		1
$-\sqrt{2}$		$\sqrt{2}$
-1		1

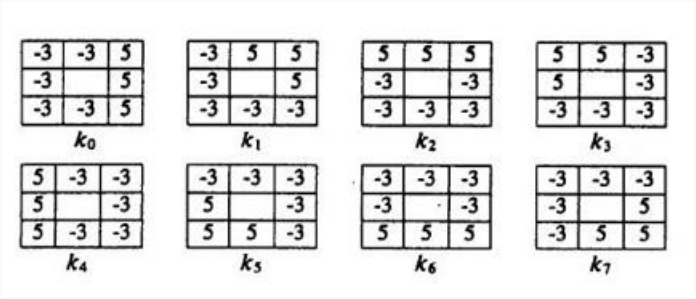
f_2

gradient magnitude: $\sqrt{f_1^2 + f_2^2}$

If gradient magnitude >= 30, output(r, c) = 0, else 255.

(e) Kirsch's Compass Operator

For pixel (r, c), calculate k_n by the following mask, (r, c) corresponds to the center of the mask.



gradient magnitude: $\max_{n,n=0,\ldots,7} k_n$

If gradient magnitude >= 135, output(r, c) = 0, else 255.

(f) Robinson's Compass Operator

For pixel (r, c), calculate r_n by the following mask, (r, c) corresponds to the center of the mask.

-1		1
-2		2
-1		1

r_0

	1	2
-1		1
-2	-1	

r_1

1	2	1
-1	-2	-1

r_2

2	1	
1		-1
	-1	-2

r_3

1		-1
2		-2
1		-1

r_4

	-1	-2
1		-1
2	1	

r_5

-1	-2	-1
1	2	1

r_6

-2	-1	
-1		1
	1	2

r_7

gradient magnitude: $\max_{n,n=0,\ldots,7} r_n$

If gradient magnitude >= 43, output(r, c) = 0, else 255.

(g) Nevatia-Babu 5x5 Operator

For pixel (r, c), calculate N_n by the following mask, (r, c) corresponds to the center of the mask.

100	100	100	100	100
100	100	100	100	100
0	0	0	0	0
-100	-100	-100	-100	-100
-100	-100	-100	-100	-100

0°

100	100	100	100	100
100	100	100	78	-32
100	92	0	-92	-100
32	-78	-100	-100	-100
-100	-100	-100	-100	-100

30°

100	100	100	32	-100
100	100	92	-78	-100
100	100	0	-100	-100
100	78	-92	-100	-100
100	-32	-100	-100	-100

60°

-100	-100	0	100	100
-100	-100	0	100	100
-100	-100	0	100	100
-100	-100	0	100	100
-100	-100	0	100	100

-90°

-100	32	100	100	100
-100	-78	92	100	100
-100	-100	0	100	100
-100	-100	-92	78	100
-100	-100	-100	-32	100

-60°

100	100	100	100	100
-32	78	100	100	100
-100	-92	0	92	100
-100	-100	-100	-78	32
-100	-100	-100	-100	-100

-30°

gradient magnitude: $\max_{n,n=0,\ldots,5} N_n$

If gradient magnitude >= 12500, output(r, c) = 0, else 255.