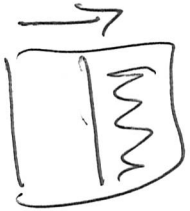
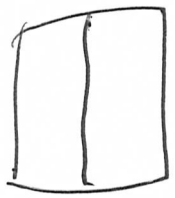
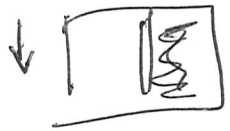
Edge Detection 140-153

i. differencing = differentiation



$$edge = f_{x,y} - f_{x+1,y}$$





$$edge = f_{x,y} - f_{x,y+1}$$

~~edge~~ $edge = 2f_{x,y} - f_{x+1,y} - f_{x,y+1}$

2	-1
-1	

w/ better way?

(A) $f(x+\Delta x) = f(x) + \Delta x f'(x) + \frac{\Delta x^2}{2!} f''(x) + \cdots$

| 1 | -1 |

$$f'(x) = \frac{f(x+\Delta x) - f(x)}{\Delta x} + O(\Delta x) \leftarrow \frac{\Delta x^2}{\Delta x}$$

(B) $f(x-\Delta x) = f(x) - \Delta x f'(x) + \frac{\Delta x^2}{2!} f''(x) - \frac{\Delta x^3}{3!} f'''(x) + \cdots$

(A) − (B)

$$f(x+\Delta x) - f(x-\Delta x) = 2\Delta x f'(x) + O(\Delta x^3).$$

| 1 | 0 | -1 |

$$f'(x) = \frac{f(x+\Delta x) - f(x-\Delta x)}{2\Delta x} + O(\Delta x^2) \leftarrow \frac{\Delta x^3/\Delta x}{}$$

↑ better if $\Delta x^2 < \Delta x$ which is the case since $\Delta x = 1/N$

ii). include averaging.

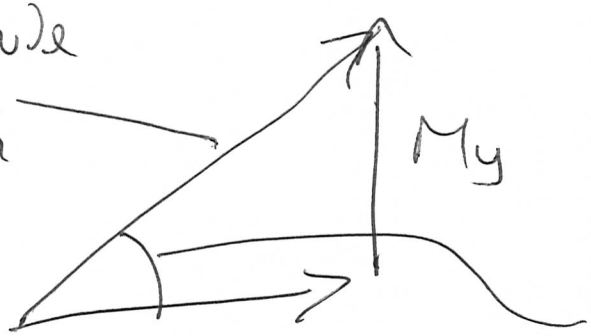
1	0	-1
1	0	-1
1	0	-1

Mx

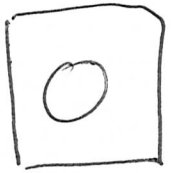
1	1	1
0	0	0
-1	-1	-1

My

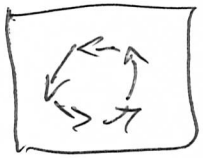
edge magnitude $= \sqrt{Mx^2 + My^2}$



edge direction $= \tan^{-1}\frac{My}{Mx}$



mag.



direction

IV. Sobel.

change → averaging

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

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

Pascal

1 1

3×3 Sobel → 1 2 1

1 3 3 1

5×5 Sobel → 1 4 6 4 1

↓ normal distribution

1 -1

1 0 -1

1 1 -1 -1

1 2 0 -2 -1

↓ difference of Gaussians