Spatial filtering

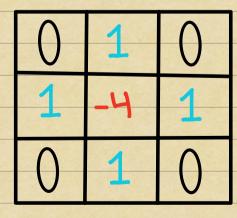-The size of the mask must be odd [3x3, 5x5, etc] to ensure it has a center

- The smallest meaningful size is 3x3

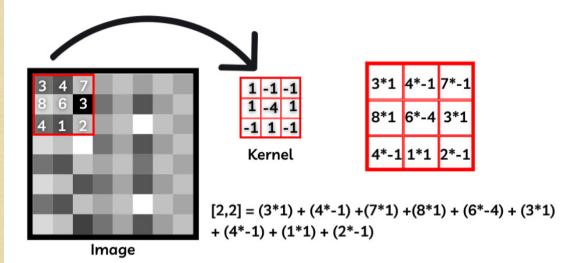-The spatial Filtering is divided into two types
   1- Linear Spatial Filtering
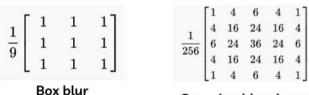   2- Nonlinear Spatial Filtering

Laplace Kernel

0	1	0
1	-4	1
0	1	0

Two Smoothing Averaging Filter Masks

Image

3	4	7
8	6	3
4	1	2

Kernel

1	-1	-1
1	-4	1
-1	1	-1

3*1	4*-1	7*-1
8*1	6*-4	3*1
4*-1	1*1	2*-1

[2,2] = (3*1) + (4*-1) +(7*1) +(8*1) + (6*-4) + (3*1)
+ (4*-1) + (1*1) + (2*-1)

$$\begin{bmatrix} 0 & 0 & 0 \\ 0 & 1 & 0 \\ 0 & 0 & 0 \end{bmatrix}$$

Identity kernel

$$\begin{bmatrix} -1 & -1 & -1 \\ -1 & 8 & -1 \\ -1 & -1 & -1 \end{bmatrix}$$

Edge detection

$$\begin{bmatrix} 0 & -1 & 0 \\ -1 & 5 & -1 \\ 0 & -1 & 0 \end{bmatrix}$$

Sharpen kernel

$$\frac{1}{9}\begin{bmatrix} 1 & 1 & 1 \\ 1 & 1 & 1 \\ 1 & 1 & 1 \end{bmatrix}$$

Box blur

$$\frac{1}{256}\begin{bmatrix} 1 & 4 & 6 & 4 & 1 \\ 4 & 16 & 24 & 16 & 4 \\ 6 & 24 & 36 & 24 & 6 \\ 4 & 16 & 24 & 16 & 4 \\ 1 & 4 & 6 & 4 & 1 \end{bmatrix}$$

Gaussian blurr kernel

Sobel Operators

z_1	z_2	z_3
z_4	z_5	z_6
z_7	z_8	z_9

$$M(x,y) \approx | (z_7 + 2z_8 + z_9) - (z_1 + 2z_2 + z_3) |$$
$$+ | (z_3 + 2z_6 + z_9) - (z_1 + 2z_4 + z_7) |$$

Ex:

	3	5	2	
	4	2	1	
	6	2	4	

$$-\text{Average} = \frac{3+5+2+4+2+1+6+2+4}{9} = 3.2 \approx 3$$

$$-\text{Laplace} = 5 + 4 + -4*2 + 1 + 2 = 4$$

$$-\text{Sobel} = |(\overset{14}{6+2*2+4}) - (\overset{15}{3+2*5+2})| +$$

$$|(\overset{8}{2+2*1+4}) - (\overset{17}{3+2*4+6})|$$

$$\Rightarrow |-1| + |-9| = -10 \approx 10$$