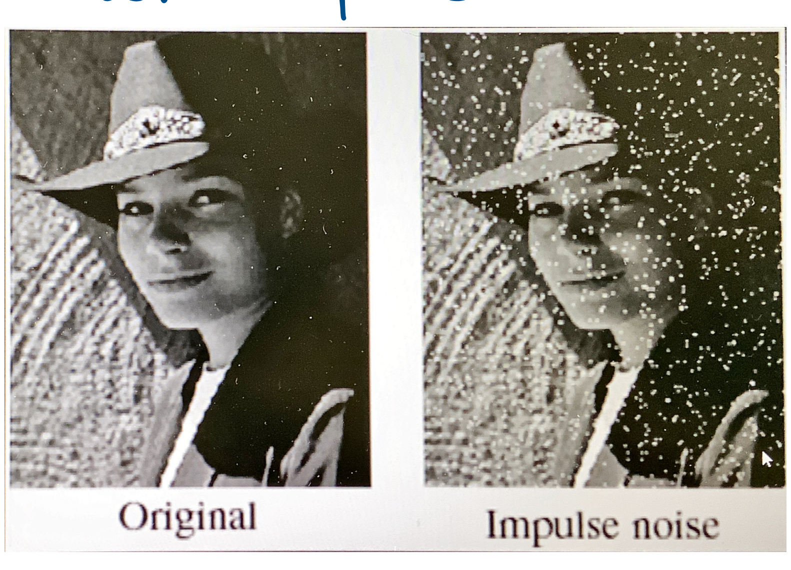
COMPUTER VISION

Saturday, 2 January 2021 12:16 PM

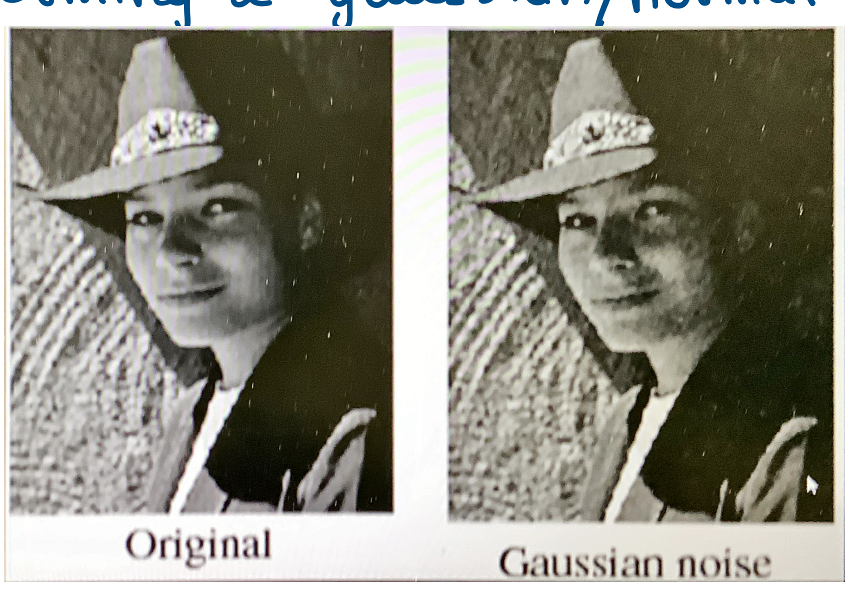
There are different types of noises that can be present in an image

① Salt and pepper noise – random occurance of black and white pixels.

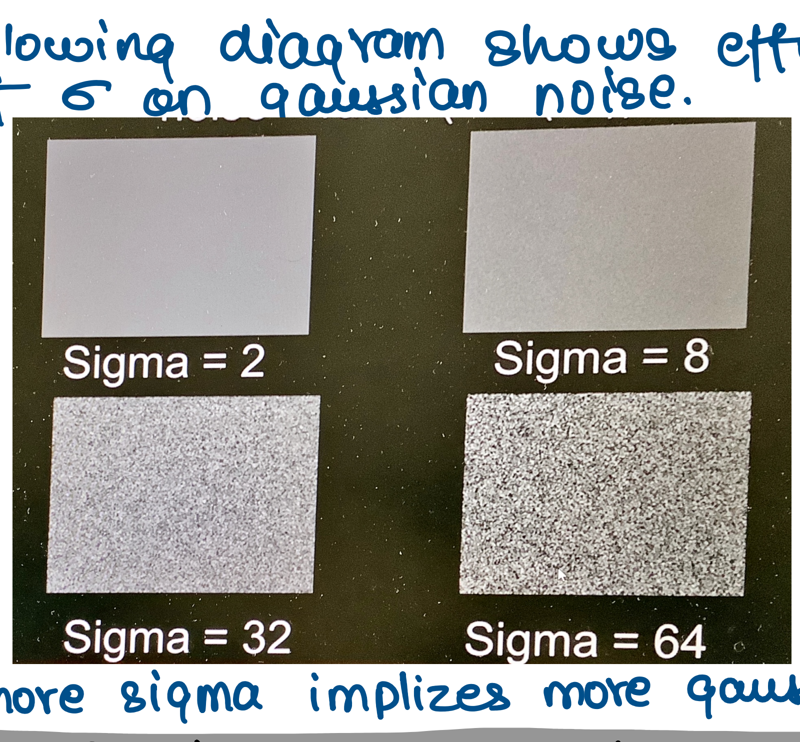
② Impulse noise – random occurance of white pixels



③ Gaussian Noise – variations in intensity forming a gaussian/normal distribution.



Following diagram shows effect of σ on gaussian noise.



⇒ more sigma implizes more gausian noise

Most of the times you would encounter gaussian noice and hence now we will learn techniques used to handle gaussian noice. This process of removing noize is termed as smoothing. and the image obtained after the original noizy image undergoes smoothing is called filter image. (unnoizy image)

(m1) Moving Averaging Method.

replace each pixel in noisy picture with the average of all the pixel values in its neighbourhood.

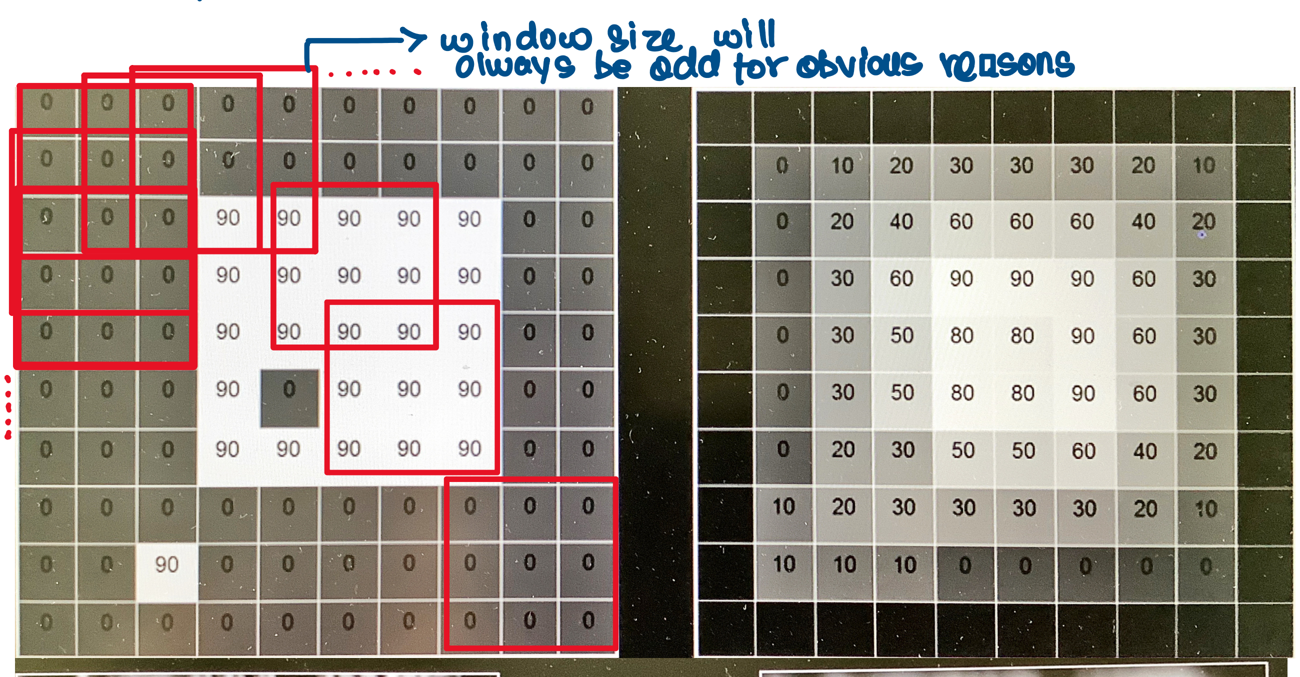
1	2	3	4	5
6	7	8	9	10
11	12	13	14	15
16	17	18	19	20
21	22	23	24	25
26	27	28	29	30

noisy picture

this bigger window is also called a filter or a convolution

hence in filtered image pixel value at 18 = pixel value at $\frac{12+13+14+17+18+19+22+23+24}{9}$

window size will always be odd for obvious reasons



mathematical equation for moving averages is

$$\text{Non noizy pixel }(i,j) = \frac{\sum_{u=-k}^{+k}\sum_{v=-k}^{+k} \text{noisy pixel }(i+u, j+v)}{(2k+1)^2}$$

where averaging window size is $(2k+1)\times(2k+1)$, in above case $k=1$

(m2) Weighted Moving Averaging Method.

1	2	3	4	5
6	7	8	9	10
11	12	13	14	15
16	17	18	19	20
21	22	23	24	25
26	27	28	29	30

Hence in filtered image pixel value at 18 = $\dfrac{a_1 \times \text{pixel value at } 12 + a_2 \times \text{pixel value at } 13 + \cdots + a_9 \times \text{pixel value at } 24}{9}$

using $a_1=1$, $a_2=2$, $a_3=1$, $a_4=2$, $a_5=4$, $a_6=2$, $a_7=1$, $a_8=2$, $a_9=1$

$$\text{Non Noisy pixel }(i,j) = \sum_{u=-k}^{+k}\sum_{v=-k}^{+k} \frac{H(u,v) \times \text{noisy pixel }(i+u, j+v)}{(2k+1)^2}$$

where $H(u,v)$ is called kernel function

$$H(u,v) = \begin{bmatrix} a_1 & a_2 & \cdots & a_{2k+1} \\ \vdots & & & \\ a_{2k+1} & & & \end{bmatrix} \times \frac{1}{(2k+1)^2}$$

In case of moving averaging with $k=1$ ⟶ $H(u,v)$ is $\frac{1}{9} \times \begin{bmatrix} 1 & 1 & 1 \\ 1 & 1 & 1 \\ 1 & 1 & 1 \end{bmatrix}$

In case of above weighted moving avg eq where $k=1$ ⟶ $H(u,v)$ is $\frac{1}{16} \times \begin{bmatrix} 1 & 2 & 1 \\ 2 & 4 & 2 \\ 1 & 2 & 1 \end{bmatrix}$

There are special kernel functions available like gaussian kernel functions which handles gaussian noise exceptionally well.