# **Lecture 02 - Image Filtering**

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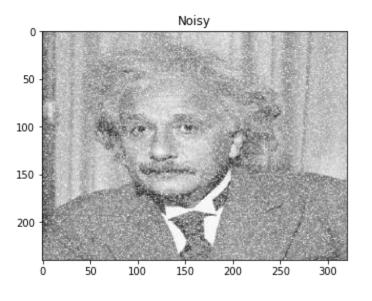
## **Topics**

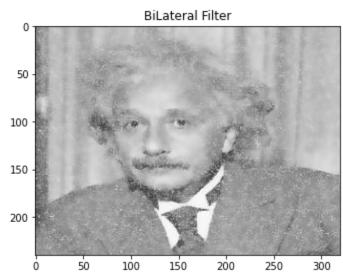
- Discussion of Practice 01
- Image Filtering
  - Convolution
  - Mean, Median, Gaussian Filters
- Practice



# **Image Filtering**

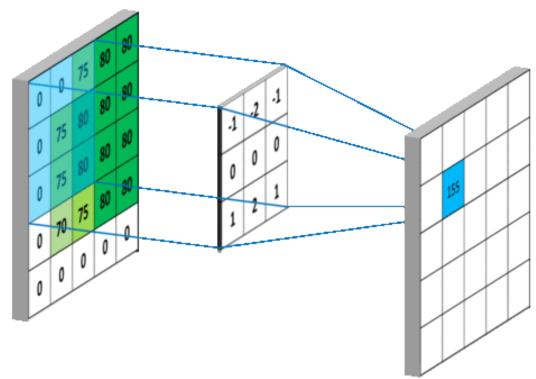
- Image Enhacement
- Noise Reduction
- Mathematical Operations





# Convolution

- Slides a kernel (a.k.a convolution filter) in the entire image
- Transforming the pixel in the center of the kernel by the weights of its neighbors



## **Convolution**

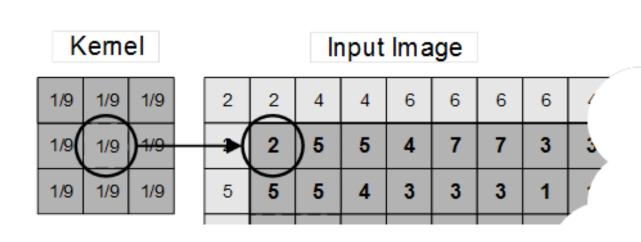
7	2	3	3	8
4	5	3	8	4
3	3	2	8	4
2	8	7	2	7
5	4	4	5	4

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

6		
	6: 5:	

#### **Mean Filter**

- Replaces the center pixel with the mean of its neighborhood
- Spreads the outlier value to its neighbors
- Details are smoothed

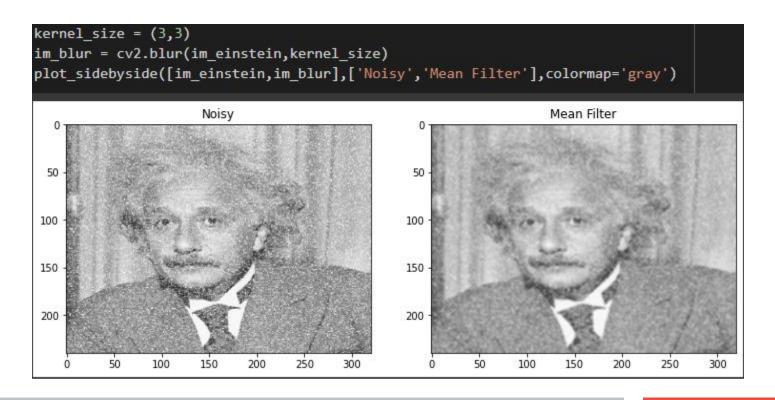


#### Output Image

4	) 4	4	5	5	5	
5	6	5	5	4	4	

#### **Mean Filter**

- Replaces the center pixel with the mean of its neighborhood
- Spreads the outlier value to its neighbors
- Details are smoothed



#### **Median Filter**

- Replaces the center pixel with by a median of its neighborhood
- Preserves more details when compared to the mean filter

Input						
1	4	0	1	3	1	
2	2	4	2	2	3	
1	0	1	0	1	0	
1	2	1	0	2	2	
2	5	3	1	2	5	
1	1	4	2	3	0	

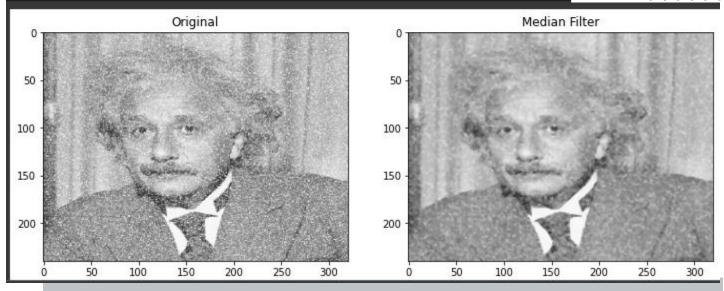
Innut

Output						
1	4	0	1	3	1	
2	1	1	1	1	3	
1	1	1	1	2	0	
1	1	1	1	1	2	
2	2	2	2	2	5	
1	1	4	2	3	0	

Output

im\_blur = cv2.medianBlur(im\_einstein,3)
plot\_sidebyside([im\_einstein,im\_blur],['Noisy','Median Filter'],colo

Sorted:0,0,1,1,1,2,2,4,4

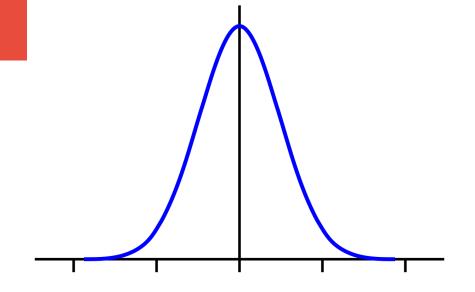


Computer Vision - Prof. André Hochuli

Lecture 02

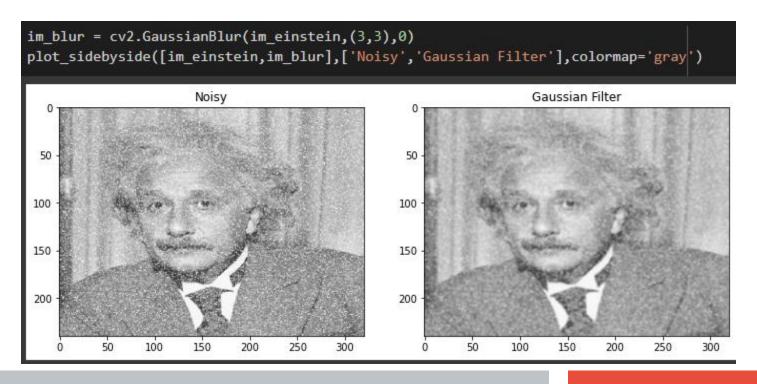
#### **Gaussian Filter**

- Gaussian distribution of pixels
- The kernel is composed of probabilities
- Weighted Mean
- The standard deviation determines the blur degree



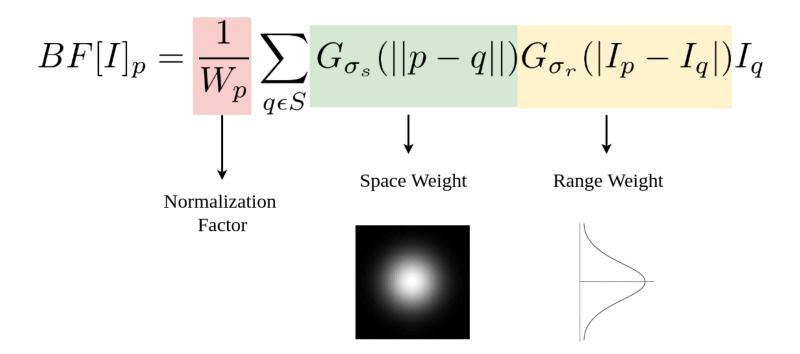
### **Gaussian Filter**

- Gaussian distribution of pixels
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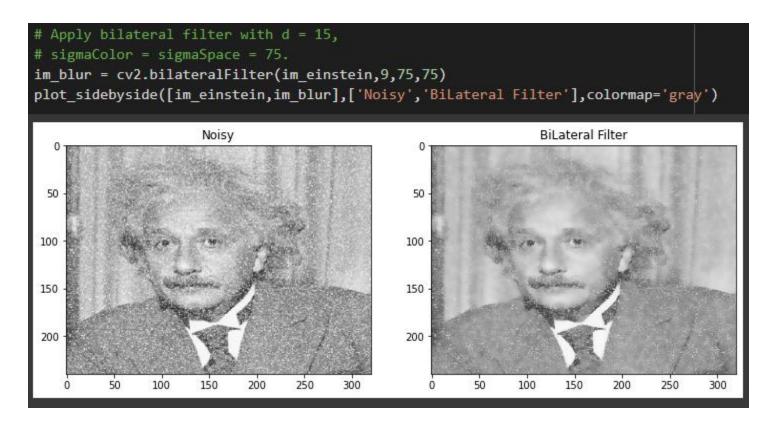
#### **Bilateral Filter**

- Gaussian Distribution based (spacial and pixel intensity)
- Add Normalization Factors and Range Weight
- Preserve details



#### **Bilateral Filter**

- Gaussian Distribution based (spacial and pixel intensity)
- Add Normalization Factors and Range Weight
- Preserve details



### **Practice**

**Link: Practice 02**