1 - Gaussian Filter Creation

- The values of σ can be chosen based on the filter size to ensure a proper Gaussian distribution
- Write the custom function to create Gaussian filters

$G(x,y) = 1/2\pi\sigma^2 \exp(- x^2 + y^2 / 2\sigma^2)$

2- image loading

We will use libraries like Pillow

3 - apply Gaussian filter for convolution

- We will loop over the picture and apply the Gaussian filter to each pixel

4- Compute PSNR

Write the custom function to create PSNR

- $PSNR = 10.\log(10) * (MAX^6/MSE)$

Max: possible pixel value of the image

MSE: is calculated between the original and the filtered image

2 -

1 - Gaussian Filter Creation

- The values of σ can be chosen based on the filter size to ensure a proper Gaussian distribution
- Write the custom function to create Gaussian filters

$G(x,y) = 1/2\pi\sigma^2 \exp(- x^2 + y^2 / 2\sigma^2)$

2. Image loading

- The pillow will be used to load the image, which will then be converted to a grayscale Numpy array
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3- Apply Gaussian Filter

I

will reuse the convolution function that was previously implemented

4- Compute PSNR

Write the custom function to create PSNR

- $PSNR = 10.\log(10) * (MAX^6/MSE)$

Max: possible pixel value of the image

MSE: is calculated between the original and the filtered image

Note: Gaussian Filter with sigma values of 1, 10, and 30, all of size 3*3

- Each filter is normalized, ensuring that its value sums up to 1
- Load the image using pillow and convert it to a Numpy array
- Apply the Gaussian Filters using the convolution function and compute the PSNR
- Each filtered image compared to the original image

3

Comparison Results :

- 3x3 Gaussian Filter: PSNR = 36.10
- 7x7 Gaussian Filter: PSNR = 34.99
- 11x11 Gaussian Filter: PSNR = 34.99

The filter size increases, and the PSNR slightly decreases. A larger filter size means more blurring

- Each pixel's new value is the avg of a large number of surrounding pixels
- The slight reduction in PSNR with larger filters indicates that the image losing some of its original quality due to an increase in the blurring

- Sigma 1 Gaussian Filter: PSNR = 36.10
- Sigma 10 Gaussian Filter: PSNR = 35.34
- Sigma 30 Gaussian Filter: PSNR = 35.34

The PSNR decreases as the Sigma value increases

- The sigma in a Gaussian filter determines how spread out and how intense the blur is
- A higher sigma results in a more spread out and intense blur
- A decrease in PSNR with higher sigma values indicates a loss in fidelity to the original image due to increased blurring

Meaning of PSNR Values

- PSNR is a measure used to assess the quality of a reconstructed or processed image compared to its original version
- Higher PSNR values typically indicate better quality, meaning the processed image is closer to the original
- The PSNR values you have obtained are all above 30 d, which generally indicates good quality for image processing tasks
- Removing noise or unwanted details (higher blurring) and keeping the original quality and details of the image

Conclusion :

- Filters with smaller sizes or lower sigma values maintain image quality
- Filters with larger sizes or higher sigma values blur the image more, lowering the PSNR
- Each choice of filter size and sigma value serves different purposes

4 Unsharp mask

1 - Load Image
We will use Pillow to load the image

2 - unsharp Mask App

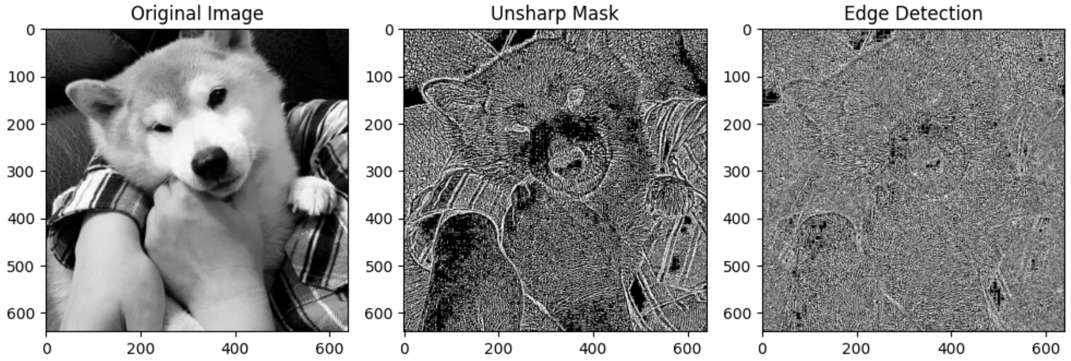
- We going to create a blurred version of the image. We can use a simple average filter for this purpose and then subtract it from the original image to create the Unsharp mask

3 - Edge Detection Mask App

- We will apply the provided Edge detection mask using the custom convolution function

4 - Display Results

- We will use ‘ matplotlib.pyplot ’ to display the results


Original Image
Unsharp Mask
Edge Detection
0
100
200
300
400
500
600
0
200
400
600