Digital Image Processing

Assignment 2

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Task 1:

In this task we want to do ***Cartoniazation*** with OpenCv. For this, we first change the color space of the image from RGB to gray, then we smooth the image with the median filter. In the next step, we extract the edges of the image with the built in function ***adaptiveThreshold()*** in OpenCV. Finally, we add the edges with black color to the smoothed image.
Another cartonization way is to reduce the number of colors in the image, and according to the second exercise of the previous assignment, we can use KMeans and reduce the number of different colors. Now, by applying KMeans, we can do the above steps again to see the better result.

Figure 1: Cartoon

Figure 2: KMeans Cartoon

Task 2:

In this task, first we want to apply Gaussian noise to the images with low to high intensities. For example, apply Gaussian noise with $\sigma = 10, 20, 30, \ldots, 100$ to each image. In the next step, we have to apply a Gaussian filter with different size and sigma on each of these noisy images. For example, we test the sigmas between 0 and 3 with a step of 0.001 and choose the appropriate size for each sigma with the formula $k = 2 \times \lfloor 3\sigma \rfloor + 1$.
Then, when we apply the Gaussian filter to the images, we calculate the MSE and PSNR value between the filtered image and the original image, and select the image with the lowest MSE

value (the highest PSNR value) Thus We find the best value for the Gaussian filter hyperparameters (σ , kernel size). In the following we show different examples and more examples are in the notebook.

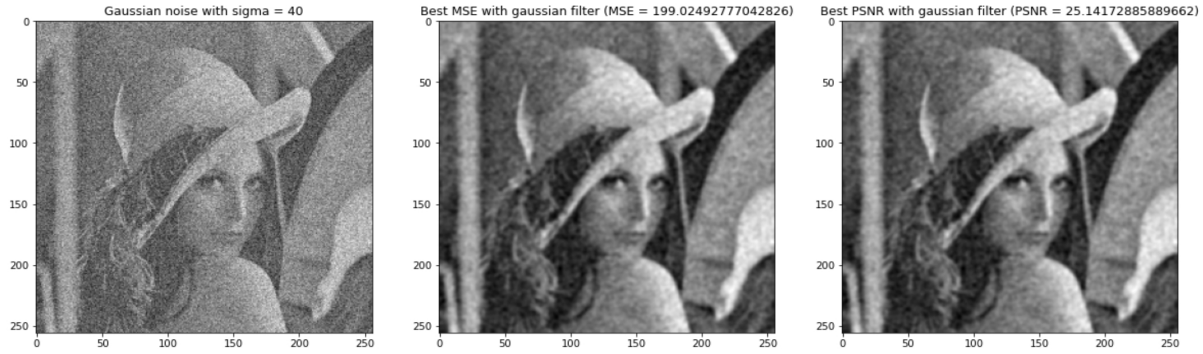

Figure 1: LeftImage: Lena image with gaussian noise with sigma = 40, CenterImage: image with best MSE after apply gaussian filter, RightImage: image with best PSNR after apply gaussian filter, Best Hyperparameter of Gaussian Filter ($\sigma = 1.223, kernelsize = (7, 7)$)

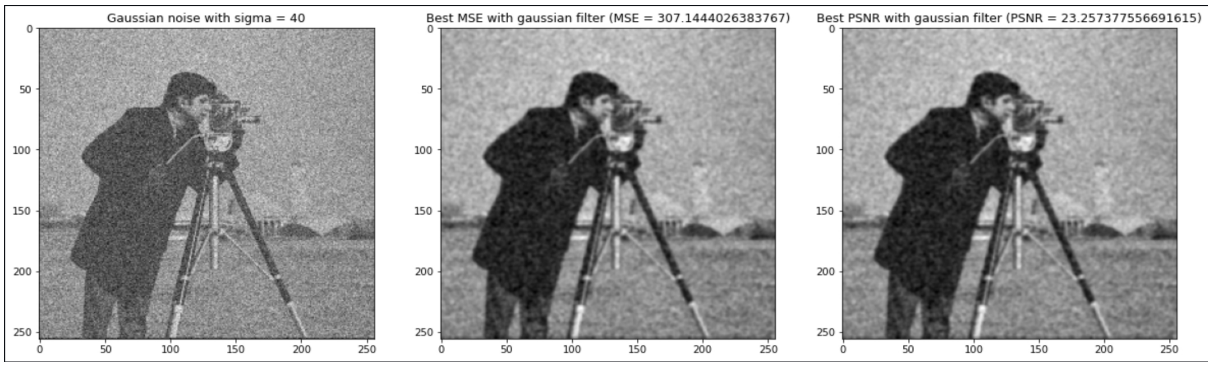

Figure 2: LeftImage: Camera man image with gaussian noise with sigma = 40, CenterImage: image with best MSE after apply gaussian filter, RightImage: image with best PSNR after apply gaussian filter, Best Hyperparameter of Gaussian Filter ($\sigma = 1.0, kernelsize = (7, 7)$)

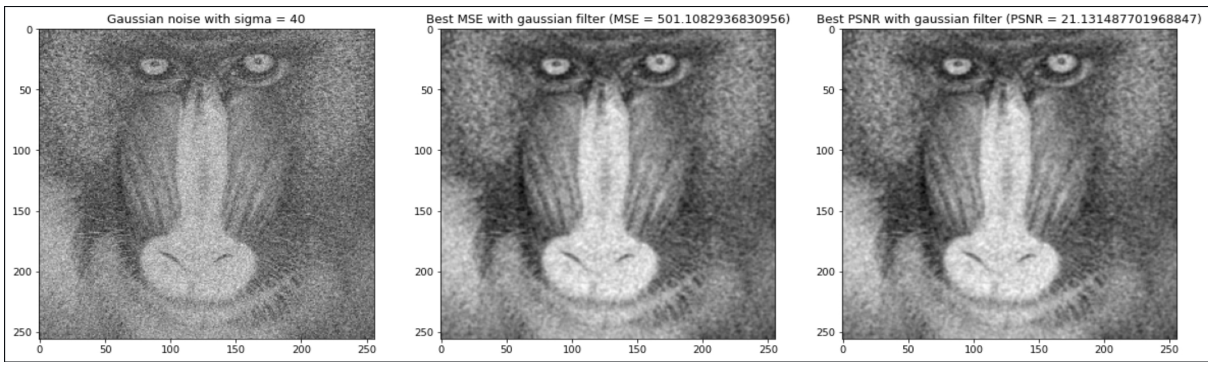

Figure 3: LeftImage: Baboon image with gaussian noise with sigma = 40, CenterImage: image with best MSE after apply gaussian filter, RightImage: image with best PSNR after apply gaussian filter, Best Hyperparameter of Gaussian Filter ($\sigma = 0.805, kernelsize = (5, 5)$)