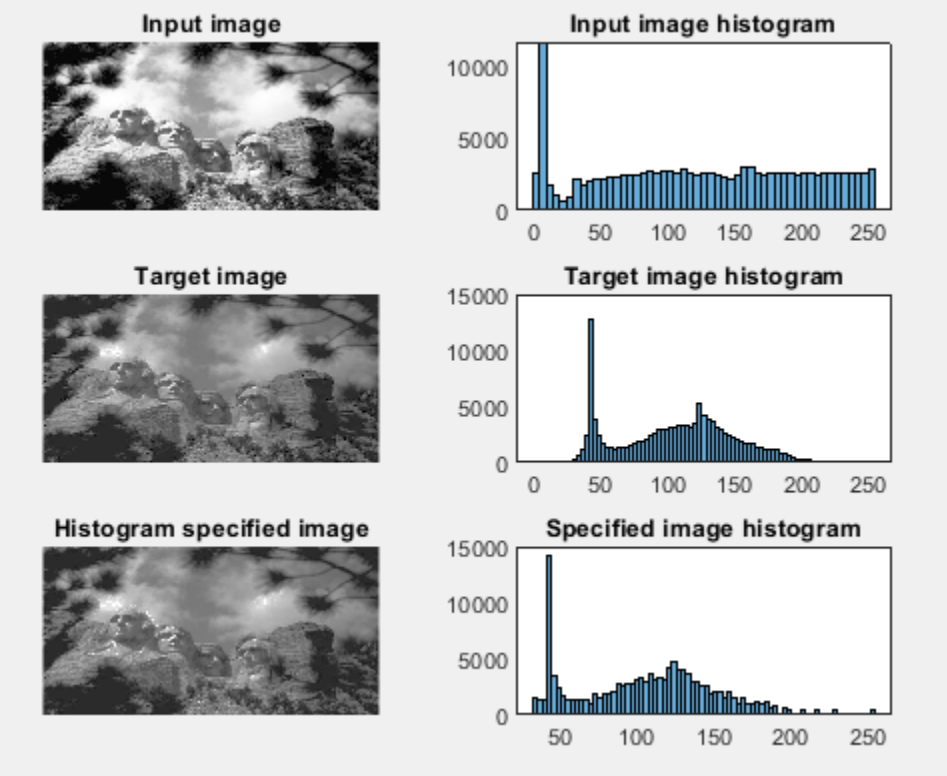
DIP Assignment

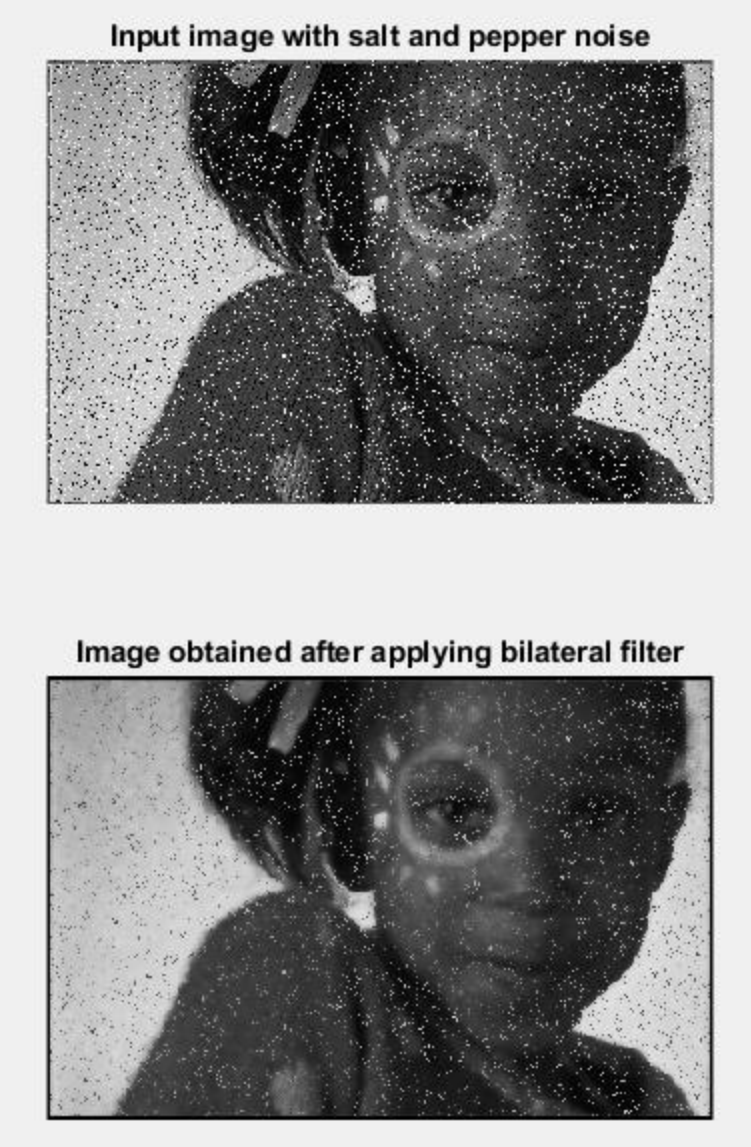
Q1. Histogram specification is a method in which histogram of the given image is transformed to match a specified image histogram. In this first both image histograms are equalized, next CDFs of both are computed in the second stage which is used for a mapping function which maps the original histogram to the specified one.

In this question the input image had a uniformly distributed histogram and a lighter contrast while the specified image had darker image intensities thus its histogram was concentrated in a range of pixels. The modified image obtained by Histogram specification also has darker contrast as the specified image and its histogram roughly matching the specified image histogram.



Q2. Bilateral filter is a filtering technique that uses both range and domain for filtering. Range filtering works on intensity values. While domain filtering takes only spatial neighborhood. We do a product of weights and do a weighted sum.

Here bilateral filter couldn't fully filter out salt and pepper noise from 1st and 3nd images with different values of sigma square d and sigma square r. We can filter it out if we had used median filter.

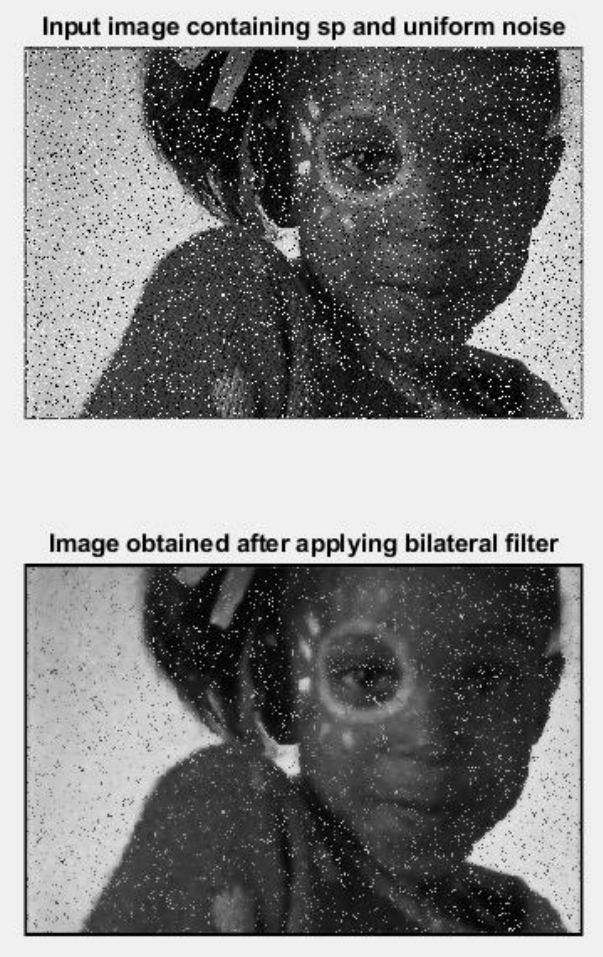


In the 2nd image containing uniform noise, the filter did a fine job filtering out uniform noise without any blurring. It cleared the uniform noise in 2nd image with sigma r and d taken as 10.

Input image containing uniform noise

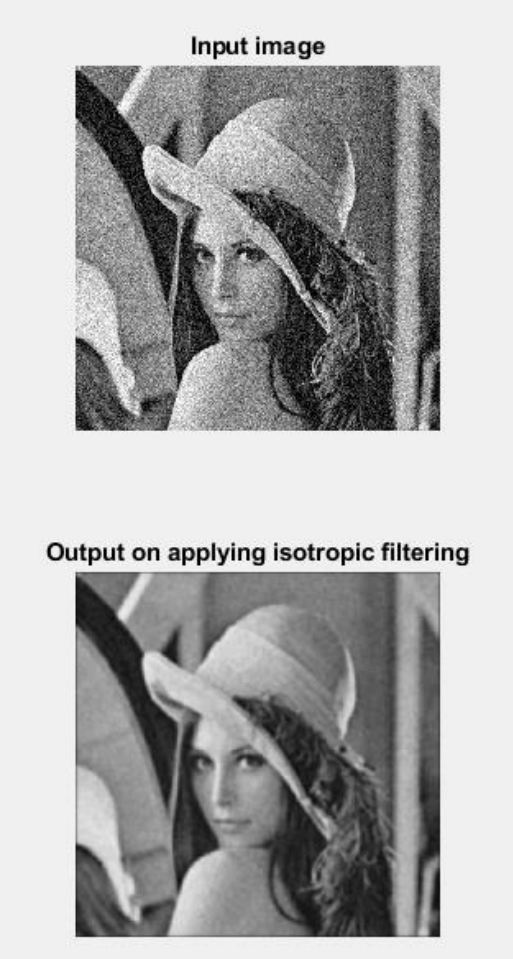
Image obtained after applying bilateral filter

However, in third image the salt pepper noise couldn't be filtered completely as if sgma_d and sigma_r values are increased though the salt pepper noise decreases to an extent still not becoming zero, but the image gives blurring. The uniform noise in the image can however be filtered using 10 as sigma_r and sigma_d value.



Q3. a) Anisotropic filter preserves the features of the image as it diffuses differently in different directions. Moreover, it uses a conduction coefficient which gives a lower value to prevent smoothening at the edges. Smoothening happens only along homogeneous regions thus giving no blur in output image. However, on increasing number of iterations image becomes blurry.

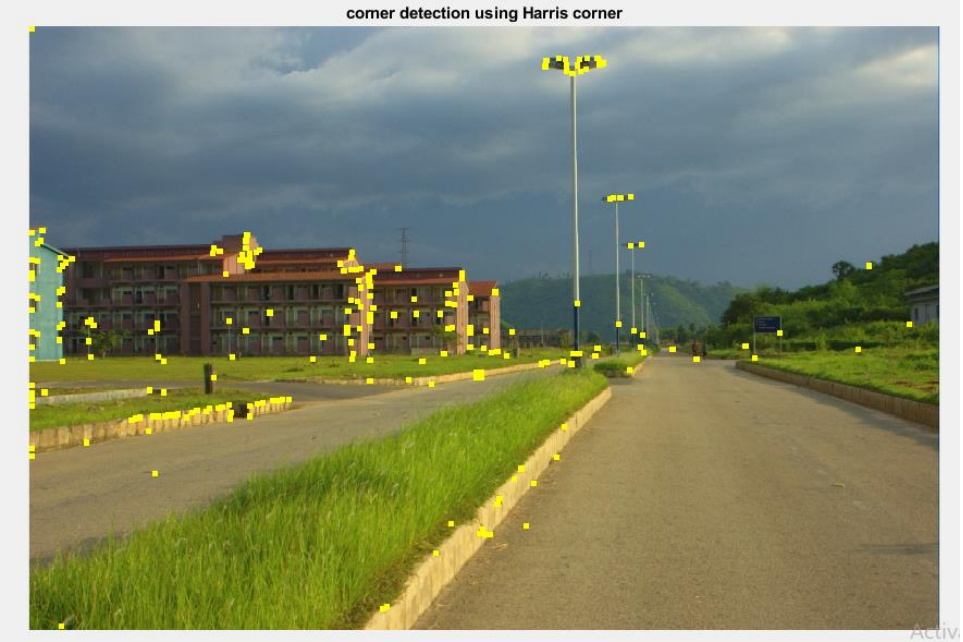
b) Isotropic filter acts as an averaging filter diffusing at the same rate in all directions. Also, the conduction coefficient is independent of location. The image output gives a slightly blurred result compared to anisotropic filter applied on the same image.



c) Non-local mean filter not only considers the neighboring pixels but also similar pixels in the entire image for averaging to filter noise. Here nonlocalmeans function in the program finds the similar patches in a 5x5 window around the patch and does a gaussian weighted averaging on them to find the value of the center pixel.

Anisotropic diffusion gives the smoother image with 10 iterations which on increasing number of iterations becomes blurry and loose important details for diagnosis, on the other hand nonlocal means technique preserves the important details in image at same time maintaining sharpness in image resulting in better contrast. Thus, NLM is a superior method compared to anisotropic filtering.

Q4. Harris corner detector uses the fact that corners have variations in two directions whereas edges have one directional variation and homogeneous region have none. Here structure tensor matrix is computed at each pixel and the eigen values are found, if both are large and positive or corner score is large it is a corner. Also, non-maximal suppression is done before finding corners.



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