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Homework Assignment 2
CS 663: Digital Image Processing

2021-08-31

Exercise-8

Figure 1: The original Barbara (*left*) and Kodak (*right*) images given to us in the problem statement

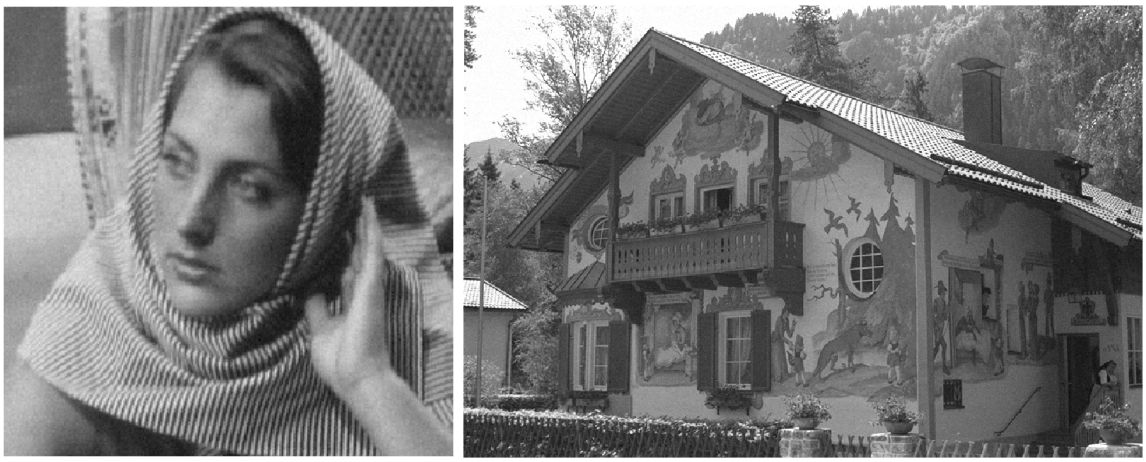

Figure 2: Barbara (*left*) and Kodak (*right*) images corrupted with Gaussian noise having mean $\mu = 0$ and standard deviation $\sigma = 5$. The effect of noise addition is clearly visible in the two images, although it is somewhat harder to identify the noise addition in the Kodak image as compared to the Barbara one.

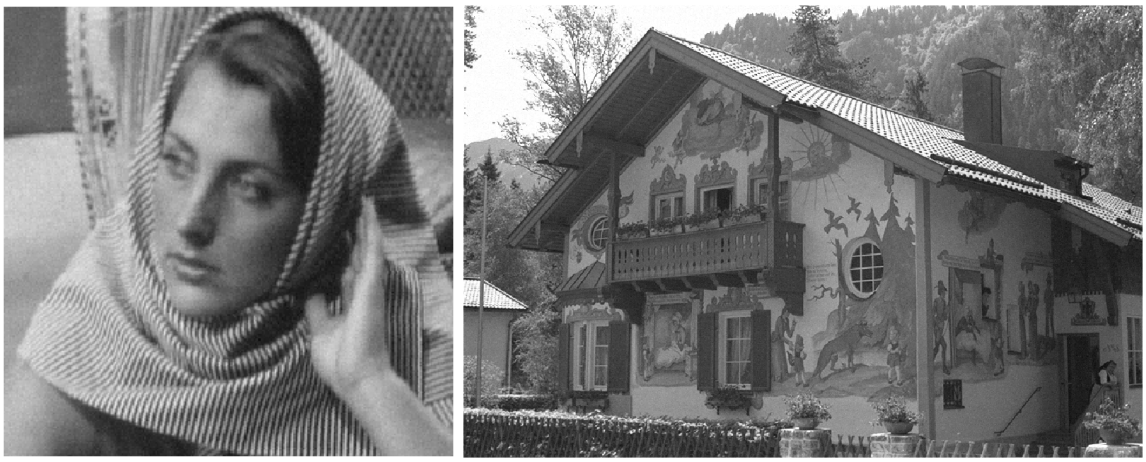

Figure 3: Barbara (*left*) and Kodak (*right*) images, with ($\mu = 0$, $\sigma = 5$) Gaussian noise, processed using a bilateral filter with ($\sigma_s = 2$, $\sigma_r = 2$). Although the effect of filtering is not very clearly evident, the image has relatively improved as compared to the corrupted ones.

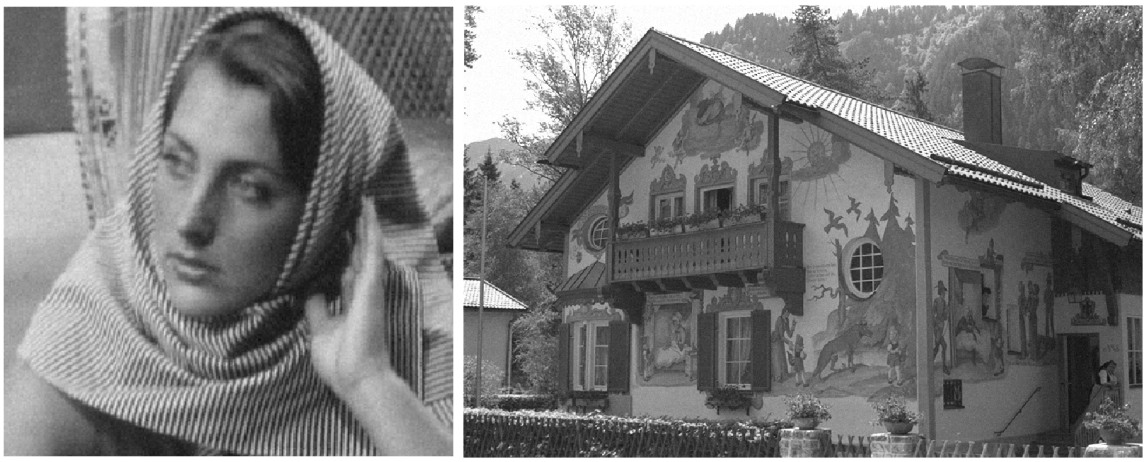

Figure 4: Barbara (*left*) and Kodak (*right*), with ($\mu = 0$, $\sigma = 5$) Gaussian noise, processed using a bilateral filter with ($\sigma_s = 0.1$, $\sigma_r = 0.1$). Such a small σ_s and σ_r practically lead to negligible smoothing effect in the images.

Figure 5: Barbara (*left*) and Kodak (*right*) images, with ($\mu = 0$, $\sigma = 5$) Gaussian noise, processed using a bilateral filter with ($\sigma_s = 3$, $\sigma_r = 15$). The result of filtering is crystal clear in the two images.

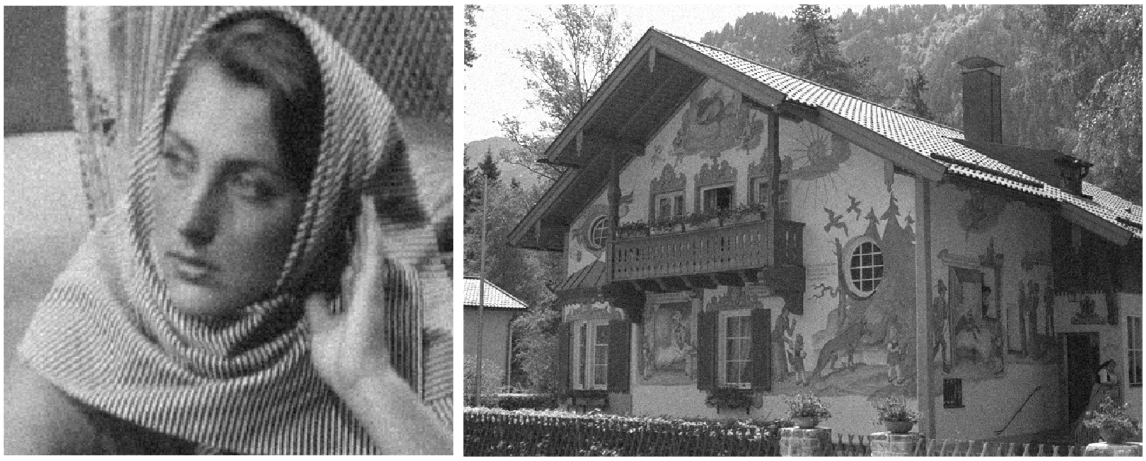

Figure 6: Barbara (*left*) and Kodak (*right*) images corrupted with Gaussian noise having mean $\mu = 0$ standard deviation $\sigma = 10$. The effect of noise addition is more pronounced in this case where the standard deviation is higher, as compared to the earlier one where the standard deviation was $\sigma = 5$.

Figure 7: Barbara (*left*) and Kodak (*right*) images, with ($\mu = 0$, $\sigma = 10$) Gaussian noise, processed using a bilateral filter with ($\sigma_s = 2$, $\sigma_r = 2$). The results from filtering, although not the best, are relatively better when compared to the same filter applied to an image corrupted with zero-mean Gaussian noise with lower σ.

Figure 8: Barbara (*left*) and Kodak (*right*) images, with ($\mu = 0$, $\sigma = 10$) Gaussian noise, processed using a bilateral filter with ($\sigma_s = 0.1$, $\sigma_r = 0.1$). Again, practically speaking, the modification in the resulting image after applying these low (σ_s, σ_r) filters is almost tending to zero.

Figure 9: Barbara (*left*) and Kodak (*right*) images, with ($\mu = 0$, $\sigma = 10$) Gaussian noise, processed using a bilateral filter with ($\sigma_s = 3$, $\sigma_r = 15$). The result of filtering is crystal clear in the two images and the noise has been filtered out effectively.