Assignment-04 : PCA based reconstruction and denoising

Dataset: MNIST digit dataset: http://yann.lecun.com/exdb/mnist/

Problem statement

a) Given a set of images of any single digit from the above dataset, compute a covariance matrix and the Eigen vector basis using the vectorized representation of these images. Project each image onto this PCA space using i) all Eigen vectors ii) Selected Eigen vectors with different values of energy thresholds (computed using the top k Eigen values). Reconstruct the original images using the projected data obtained in the cases above and comment on the quality of reconstruction based for different cases.

b) Now add up to 20% noise to the images, and perform the same experiment as above. Comment on the tradeoff between denoising and reconstruction quality for different cases of no. of principal components

[Note: In order to add Gaussian noise, you can use inbuilt function (both in matlab as well as in python, like in matlab you can use "imnoise" and in python you can use skimage.util.random_noise.). You have to take mean as 0 and variance as 0.15 as the parameters of Gaussian noise.]