Note: (1) Please upload a soft copy on D2L and do not forget to upload your code.

1. (50 points) This question is related to Principle Component Analysis. You are to apply data pre-processing techniques to a collection of handwritten digit images from the USPS dataset. You can load the whole dataset into Python using the function `loadmat` in `Scipy.io`. The matrix A contains all the images of size 16 by 16. Each of the 3000 rows in A corresponds to the image of one handwritten digit (between 0 and 9).

   (a) Implement PCA and apply it to the data using $d = 10, 50, 100, 200$ principal components. You are not allowed to use an existing code. You can use existing packages for eigen-decomposition.

   (b) Reconstruct images using the selected principal components from (a).

   (c) Report the first two reconstructed images for $d = 10, 50, 100, 200$.

   NOTE: Please do NOT forget to upload your codes. Output of the codes will not be sufficient to get the full point.