**Artificial Neural Networks**

*Exercise Session 3 – Unsupervised learning and SOM,*

*report by,*

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***Principal Components Analysis(PCA):***

Principal components analysis is the dimensionality reduction technique without reduction of the given input features. PCA is applied to the handwritten dataset of 3’s which are stored in the dataset ‘threes.mat’ and the findings are as below;

***Mean of dataset:***

The computed mean of dataset ‘threes’, Eigen values of the covariance matrix for the given dataset, the reconstructed image with 4 principal components are displayed as below;



When rebuilding the character set with the found principal components, there is reconstruction error which is remain due to the fact the number of components are reduced. The more components we choose from the output vectors to rebuild the original character, the less reconstruction error it is to be. For the first 50 components, the reconstruction error appears as below;

For the first 50 components, the reconstruction error still appears. So, with all the output vectors from PCA (k=256), the reconstruction error ideally should be ‘0’. This can be checked by calculating/plotting the reconstruction error with k=256. The same can be seen below;

As seen above, the reconstruction error is decreasing with respect to the increase in the number of principal components which in turn makes the cumulative sum of the eigen values are reaching towards 1.

***Self-Organizing Maps:***