**Introduction**

For this homework assignment we were given a Principle Component Analysis function. We were instructed to use the function in the homework assignment. We were first tasked to use it to investigate the reconstruction error and we built a graph of the reconstruction vs. the number of principal components. Next, we replicated the plot of the eigenvector plot shown in the textbook using three dimensions (three eigenvectors). Finally, we were instructed to plot the mean and the 8 principal components as image.

**Methods**

Below are algorithms that are critical to the implementation of the algorithm:

1. function [xd, xx, xxmse, evec, eval, b] = pca(data, class\_labels)
   1. Performs Principal Component Analysis. Returns the set of components of the data in the direction of the eigenvectors (xx), reconstructed dataset (xd), reconstruction error (xxmse), the calculated eigenvectors (evac), eitenvalues (eval), and the mean of the input (b).
2. function plotEval(data)
   1. Plots the Proportion of the variance vs. the eigenvector.
3. function plotPCA(data, class\_label)
   1. Plots the first three eigenvectors on a three-dimensional grid
4. function eigenfaces
   1. Displays the mean of the eigendigits and the first 8 principal components as images.

**Results**

A close up of a map

Description automatically generated

**Figure 1**. Reconstruction Error Vs. Eigenvector count

A close up of a map

Description automatically generated

**Figure 2**. Proportion of Variance With Increased Number of Eigenvectors

A close up of a map

Description automatically generated

**Figure 3**. Three-dimensional scatterplot of the first three eigenvectors

A close up of a logo

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**Figure 4**. The mean of the eigendigits

A screenshot of a cell phone

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**Figure 5**. First 8 Principle Components Displayed As Images

**Discussion**

**Software listing and executable software**

To run the software, simply run the program.