Karan Vora (kv2154)
Machine Learning Assignment 4

Problem 1):

Compute the mean of the image data of shape (100, 1900). And then subtract the mean from all data points to get the de-centered data.

$$\mu = mean(X)$$

and get x from

$$x = X - \mu$$

Computing the covariance matrix

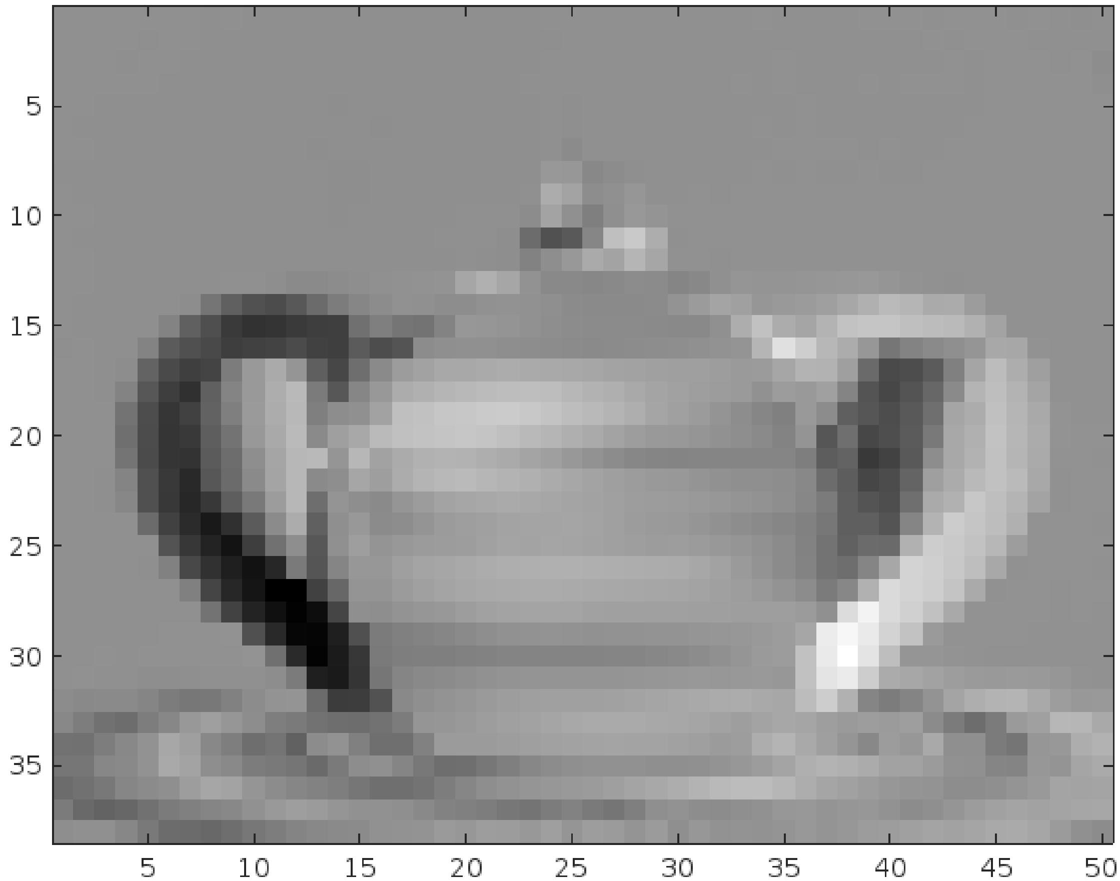
$$C = x^T x$$

Apply eigenvector Decomposition to covariance matrix

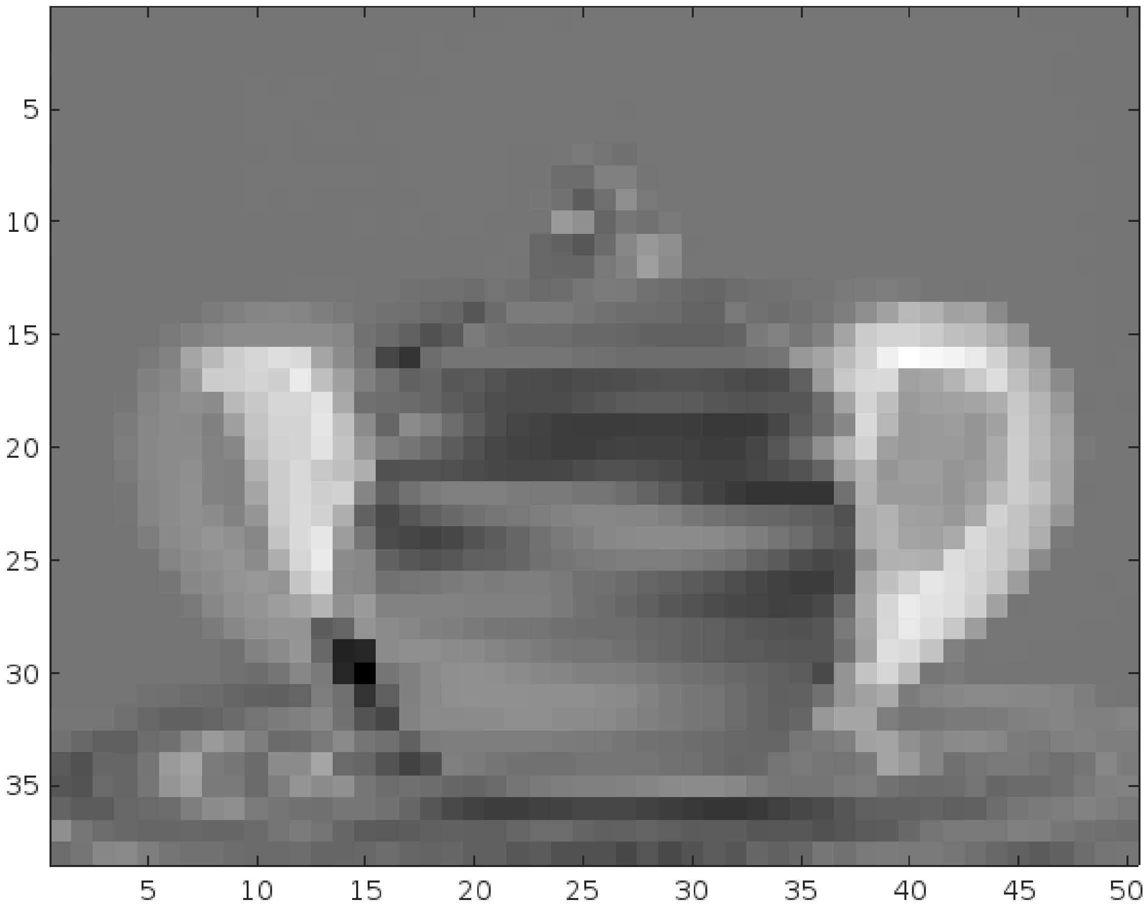
$$C = V \Lambda V^{-1}$$

The 3 most significant eigen value is

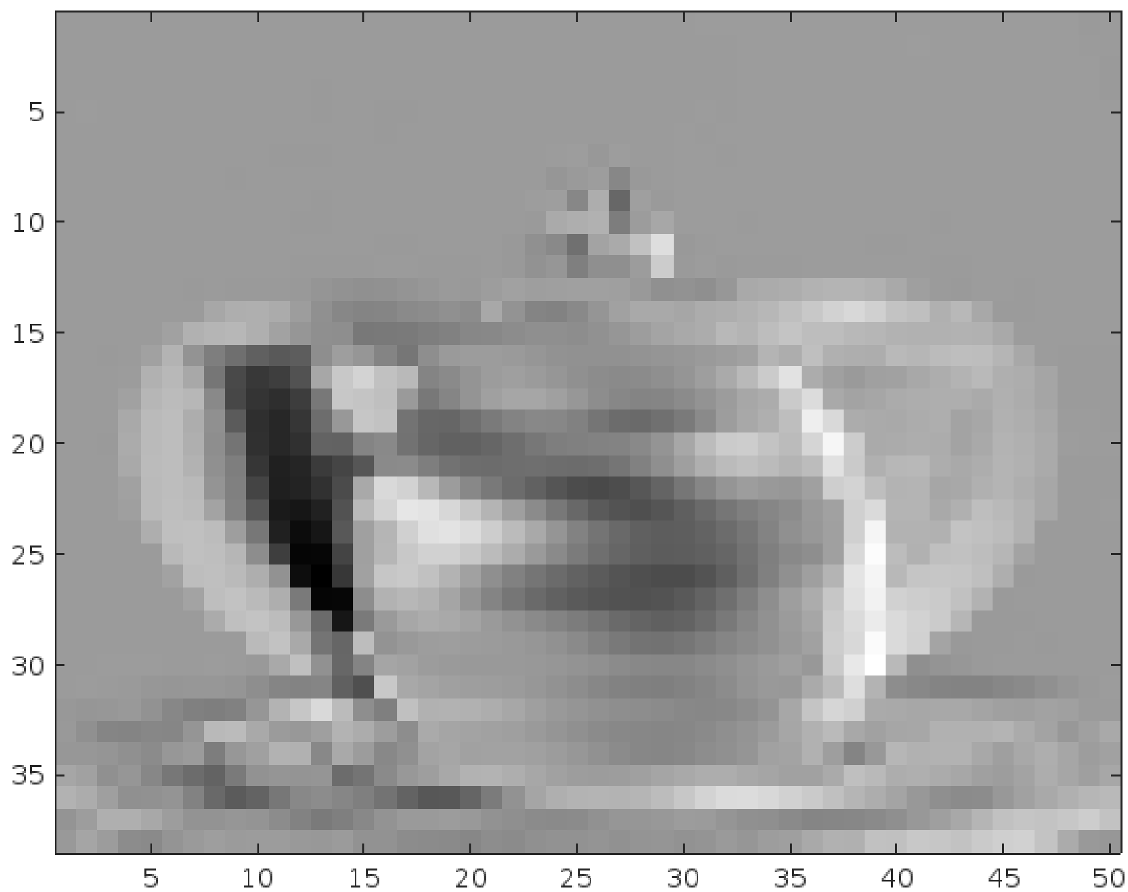
Eigen Value = 4.215022



Eigen Value = 3.016759



Eigen Value = 2.099301



The coefficient matrix is obtained by

$$c_{ij} = (X_i - \mu)^T V'_j = x_i^T V'_j$$

This is just the inner product of x and the top 3 eigenvectors

c = **xV’**

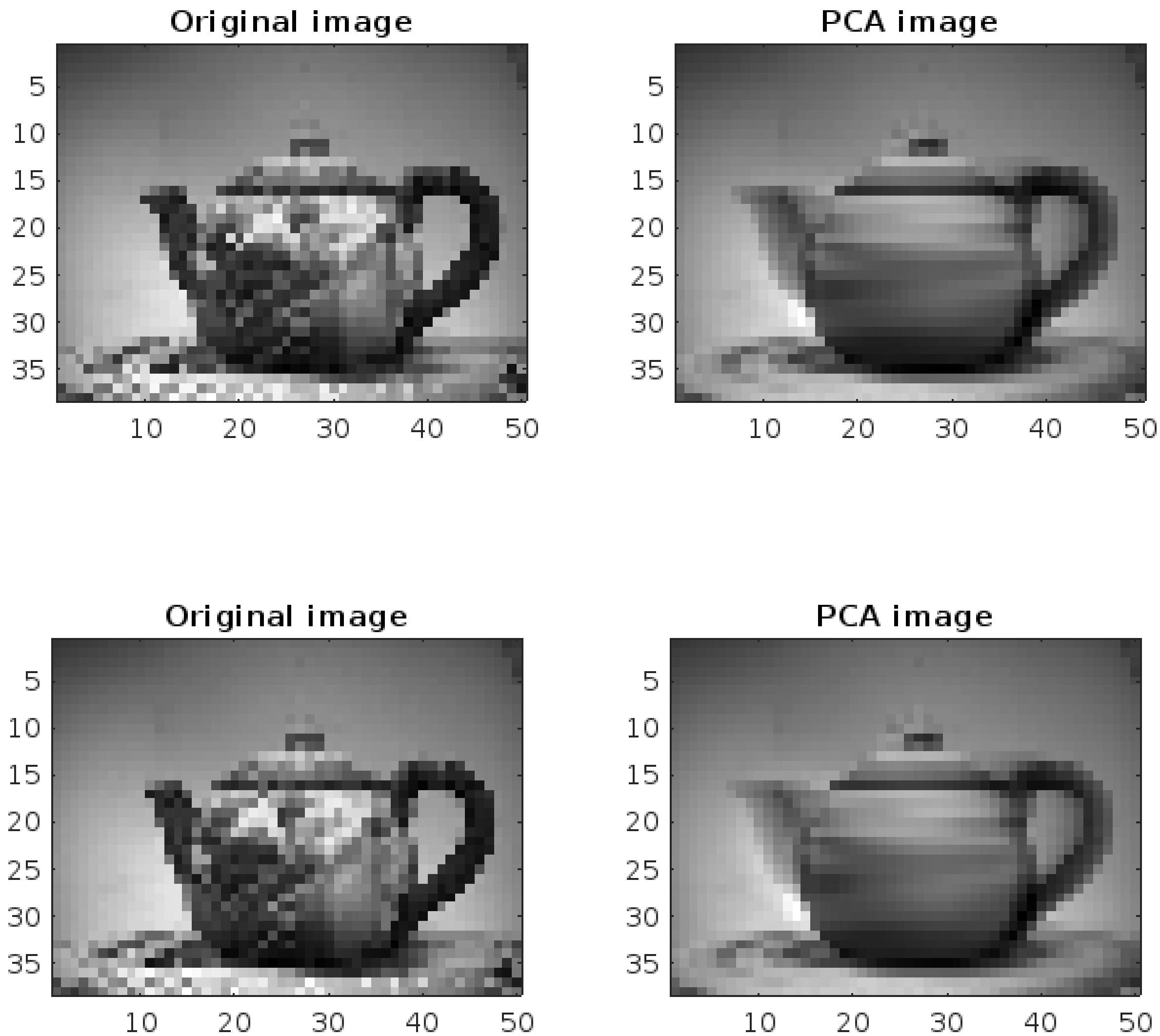
we can calculate $\hat{X}$ by

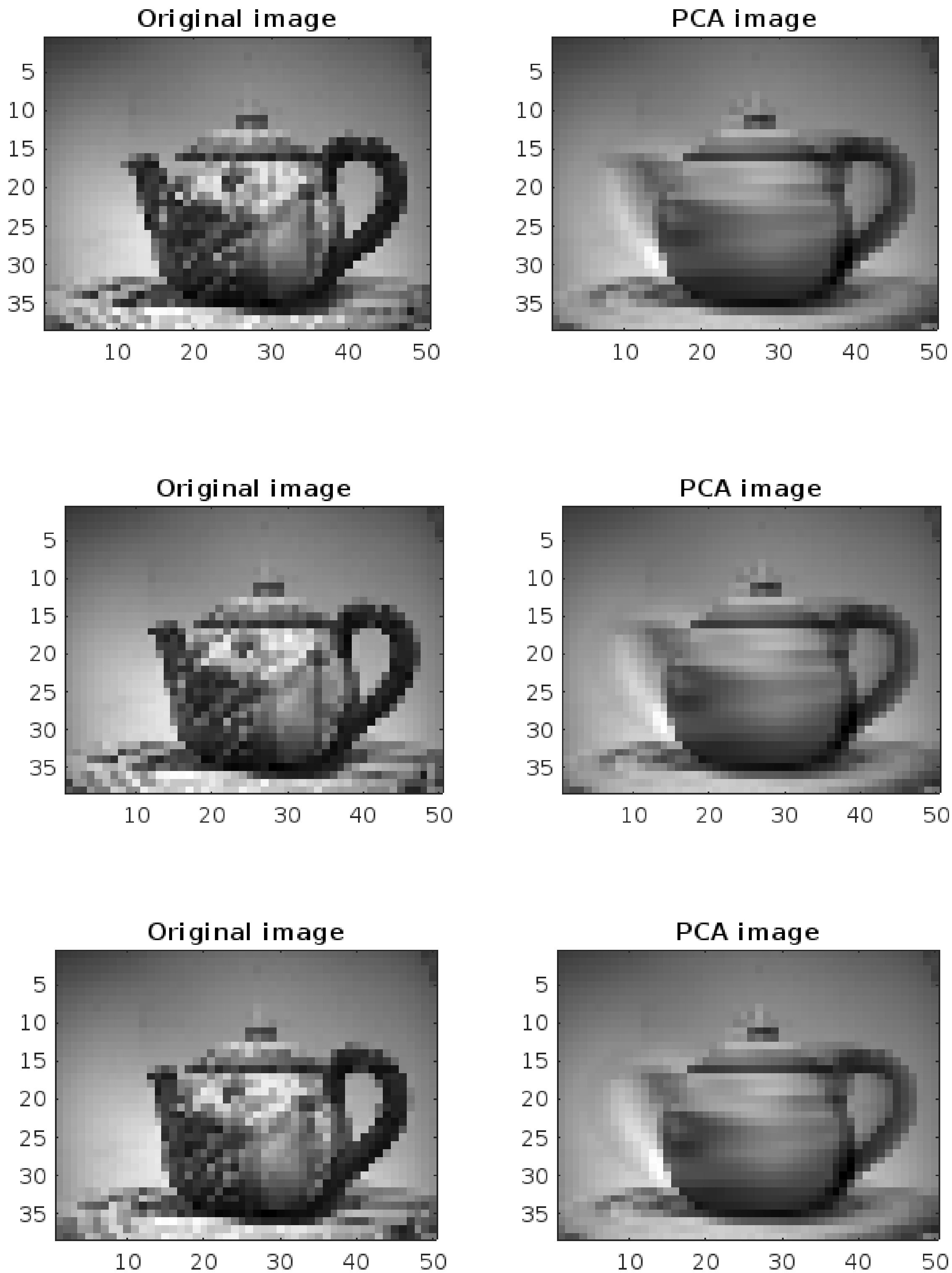
$$\hat{X} = \mu + \sum_{j=1}^{c} c_{ij} V'_j$$

which in simple terms is

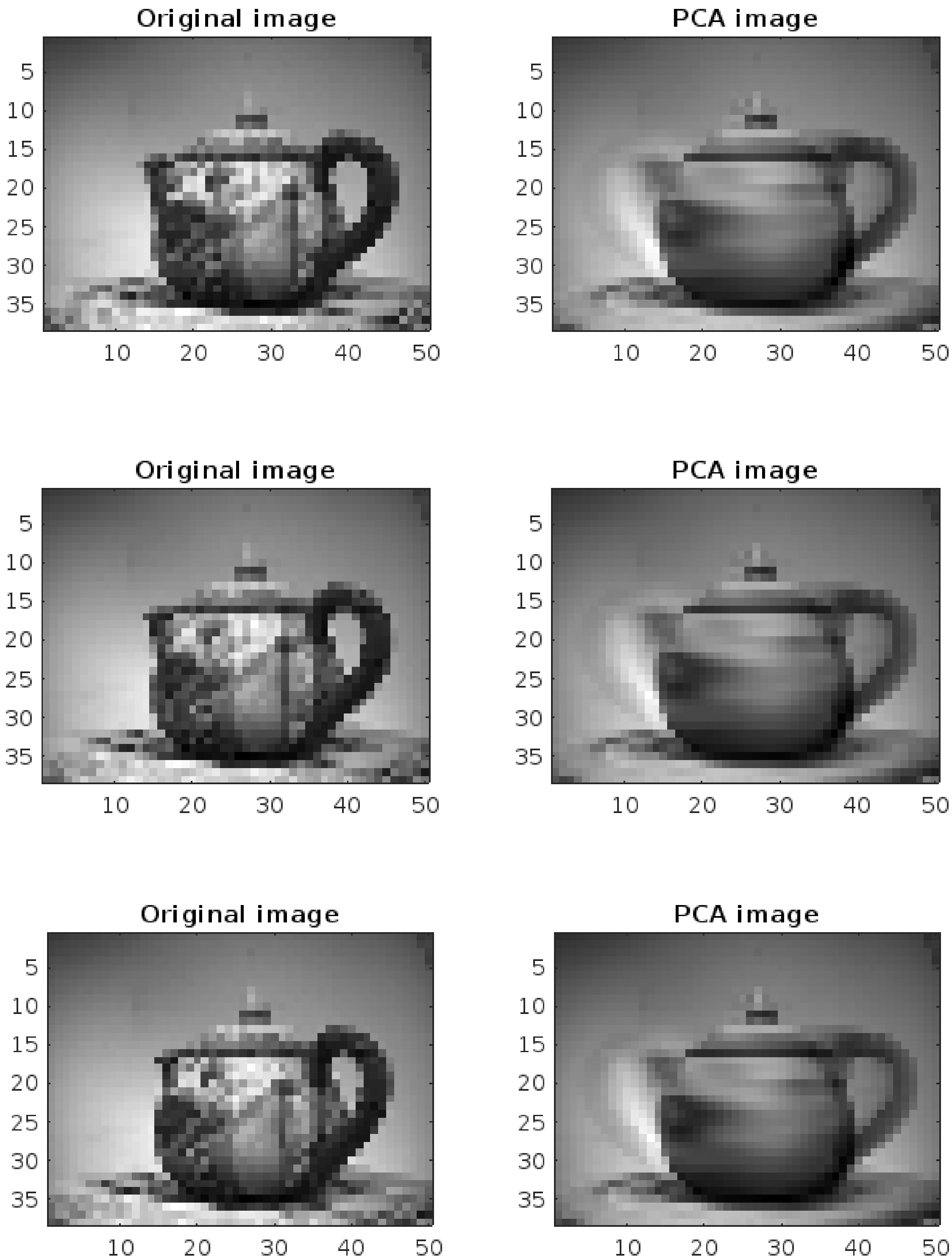
$$\hat{X} = \mu + cV'$$

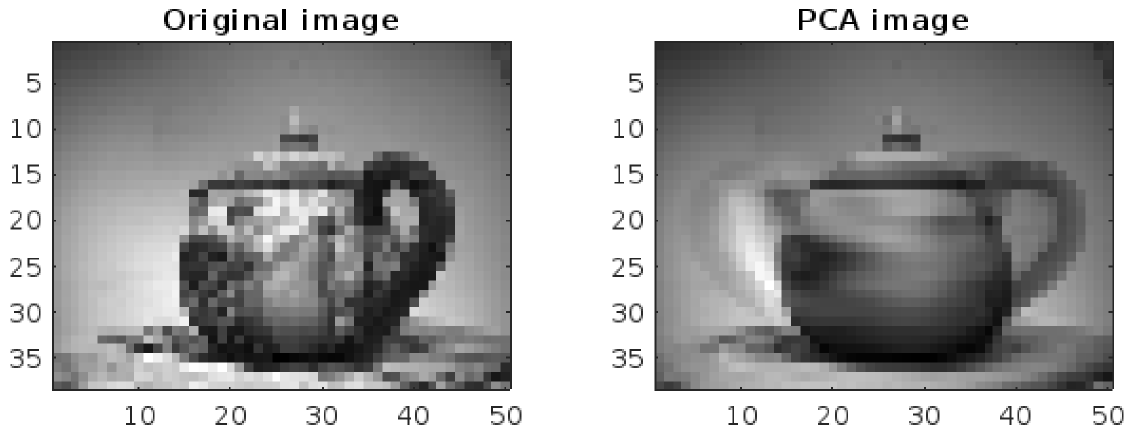
The 10 generated images are

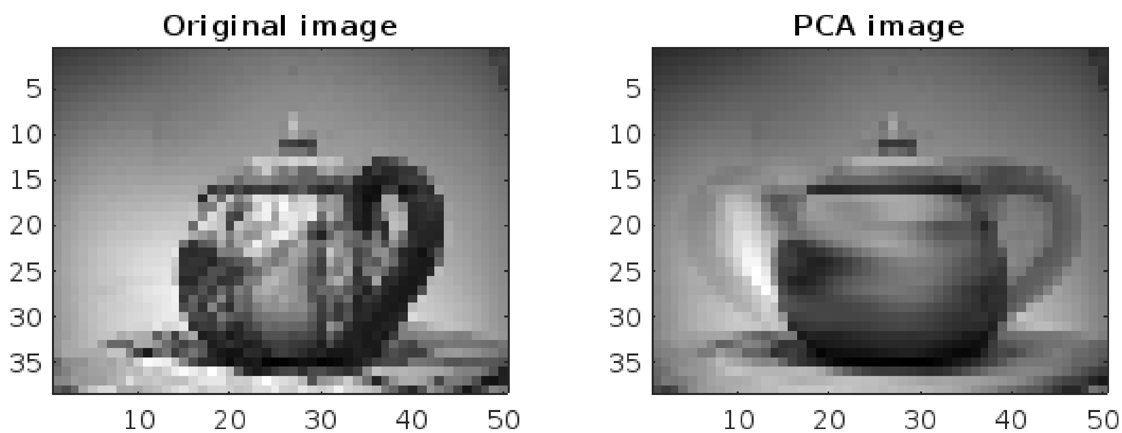

Original image
PCA image
5
10
15
20
25
30
35
10
20
30
40
50
Original image
PCA image
5
10
15
20
25
30
35
10
20
30
40
50



Original image
PCA image
Original image
PCA image
Original image
PCA image


Original image
PCA image
5
10
15
20
25
30
35
10 20 30 40 50
Original image
PCA image
5
10
15
20
25
30
35
10 20 30 40 50
Original image
PCA image
5
10
15
20
25
30
35
10 20 30 40 50





==

Problem 2):

First box 8 Apples 4 Oranges
Second box 10 Apples 2 Oranges

Probability of selecting box = $P(E_1) = P(E_2) = \frac{1}{2}$

Select Apple from First box

$P(A/E_1) = \frac{8}{12} = \frac{2}{3}$

Select Apple from Second box

P(A/E_2) = $\frac{10}{12} = \frac{5}{6}$

Applying Bayes Theorem

$$P(E_1/A) = \frac{P(E_1)P(A/E_1)}{P(E_1)P(A/E_1) + P(E_2)P(A/E_2)}$$

$$= \frac{\frac{1}{2} x \frac{2}{3}}{(\frac{1}{2} x \frac{2}{3}) + (\frac{1}{2} x \frac{5}{6})}$$

$$P(E_1/A) = \frac{4}{9}$$

==

Problem 3):