

DLCV HW1

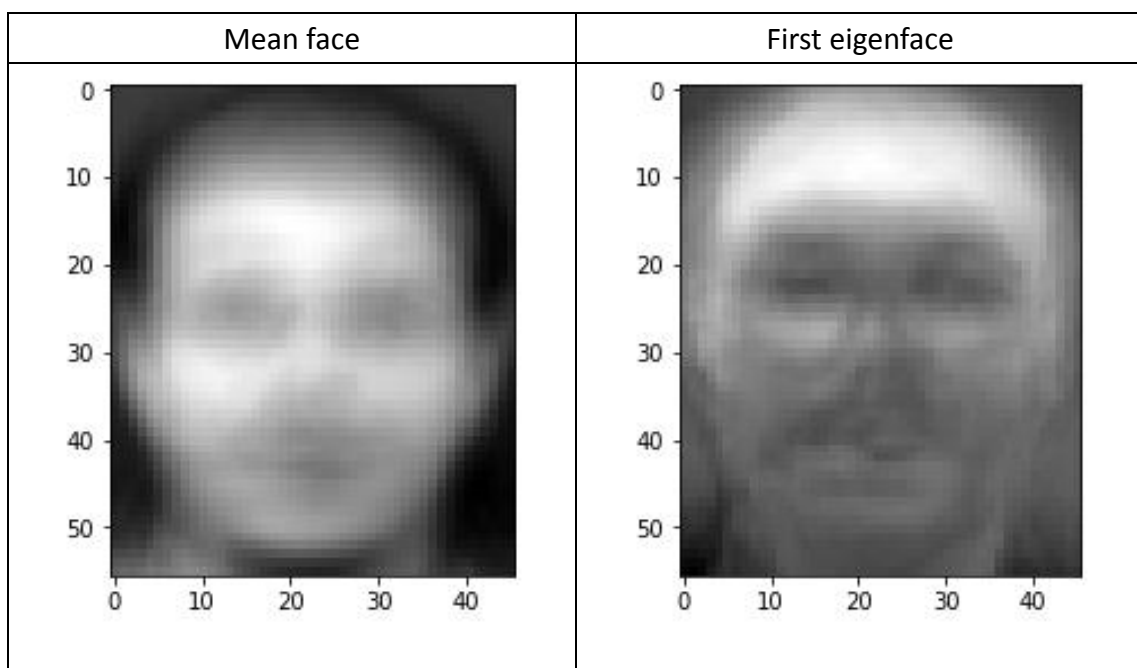
Problem 1: Bayes Decision Rule (30%)

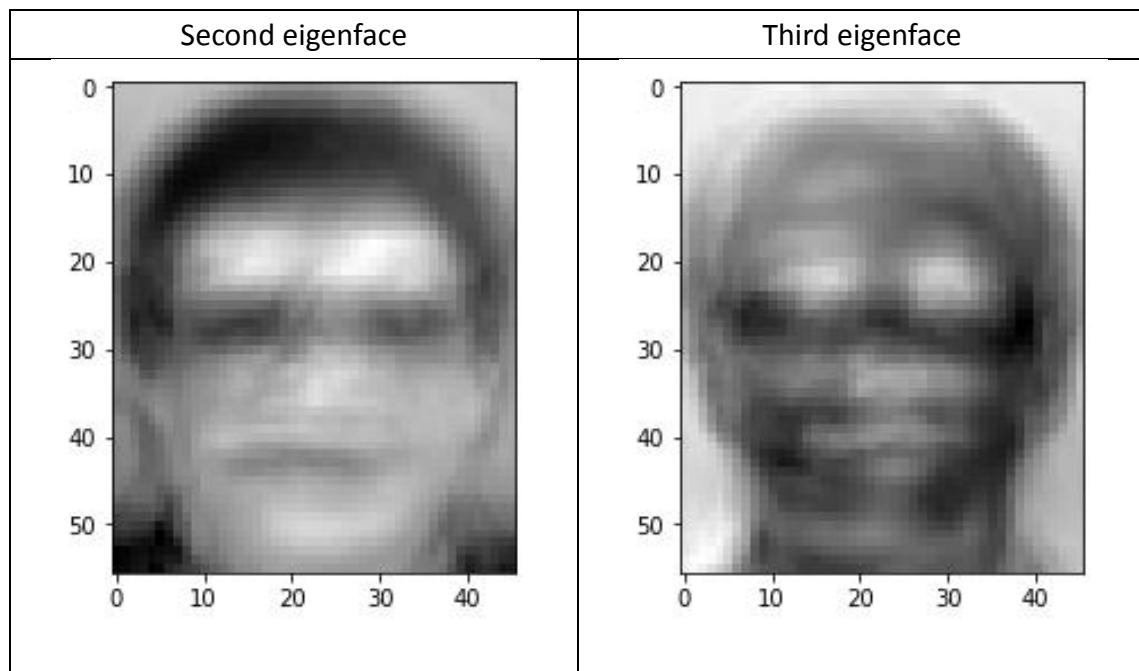
For a 2-class problem based on a single feature x , the class PDFs are defined as below:
 $p(x|\omega_1)$ = uniform over $(0, 5)$ $p(x|\omega_2)$ = uniform over $(3, 6)$. Determine the minimum P_e decision scheme with $P(\omega_1) = 3/4$. Please state clearly what the decision regions R_1 and R_2 are. What is the resulting P_e ?

$$\begin{aligned}
 P(\omega_1) &= \frac{3}{4} & P(\omega_2) &= \frac{1}{4} & P(x|\omega_1) &\sim U(0, 5) & P(x|\omega_2) &\sim U(3, 6) \\
 \text{Tx threshold} &= 5 \\
 P_e &= \int_{R_1} p(x|\omega_1) p(\omega_1) dx + \int_{R_2} p(x|\omega_2) p(\omega_2) dx \\
 &= \int_5^\infty p(x|\omega_1) p(\omega_1) dx + \int_{-\infty}^5 p(x|\omega_2) p(\omega_2) dx \\
 &= \frac{1}{4} \cdot \frac{2}{3} = \frac{1}{6}
 \end{aligned}$$

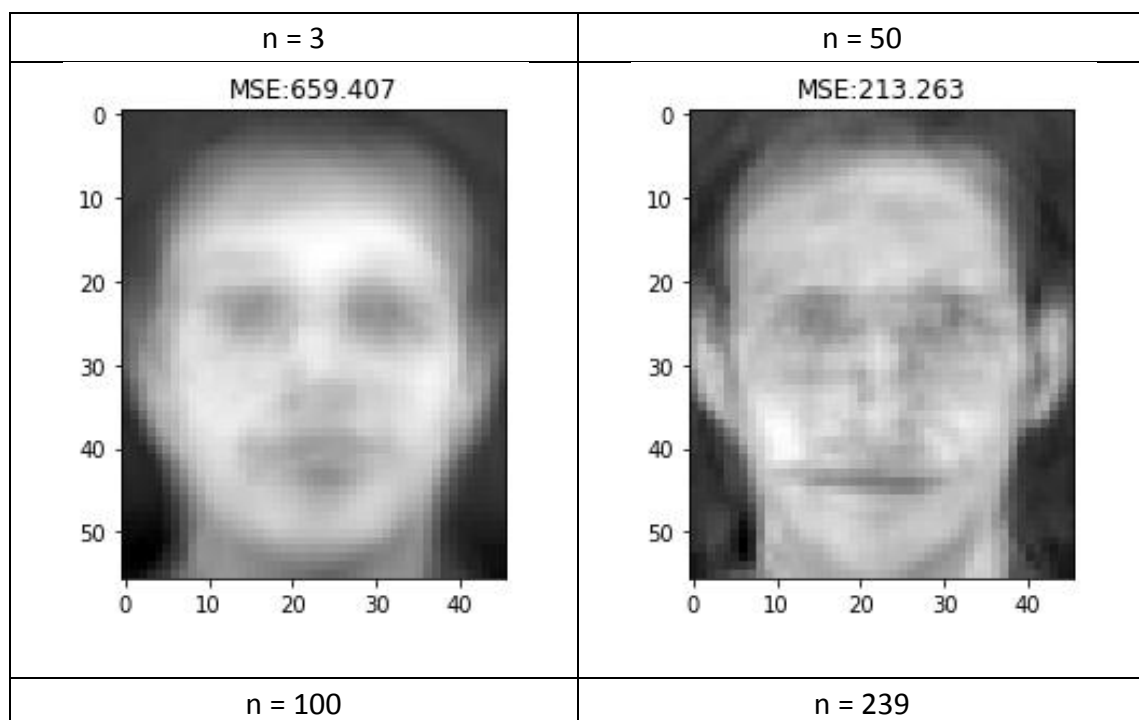
Problem 2: Principal Component Analysis and k-Nearest Neighbors Classification (70%)

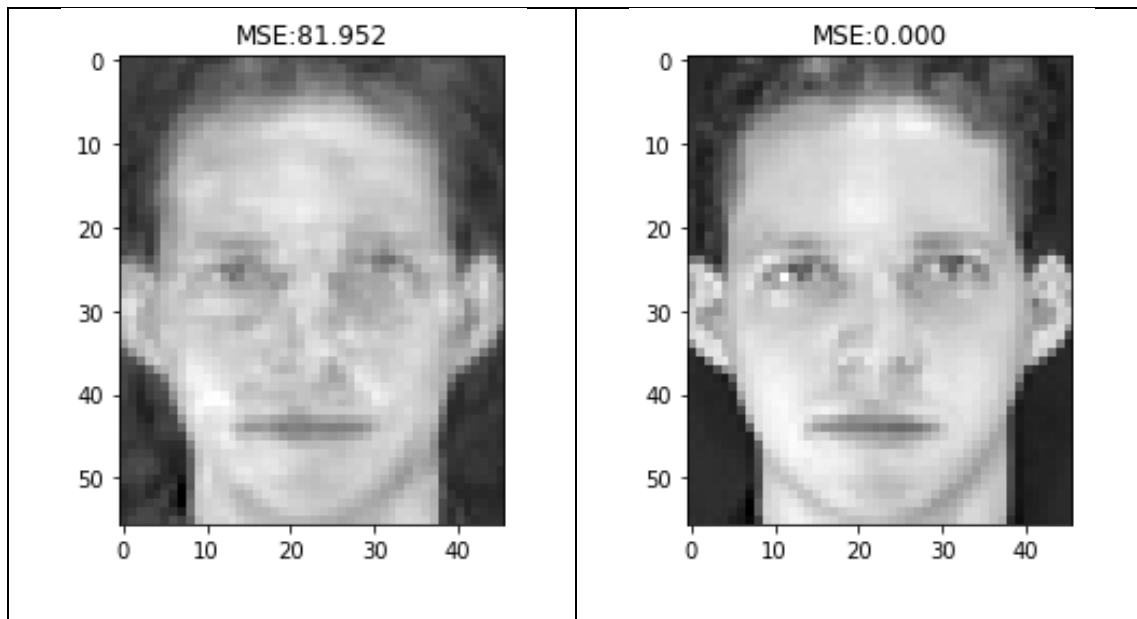
(a) (10%) Perform PCA on the training set. Plot the mean face and the first three eigenfaces.





(b) (25%) Take person1 image1, and project it onto the above PCA eigenspace. Reconstruct this image using the first $n = 3, 50, 100, 239$ eigenfaces. For each n , compute the mean square error (MSE) between the reconstructed face image and person1 image1. Please plot these reconstructed images, with the corresponding MSE values.





(c) (35%) To apply the k-nearest neighbors classifier to recognize test set images, please determine the best k and n values by 3-fold cross-validation. For simplicity, the choices for such hyperparameters are $k = \{1, 3, 5\}$ and $n = \{3, 50, 159\}$. Please show the crossvalidation results and explain your choice for (k, n) . Finally, use your hyperparamter choice to report the recognition rate on the test set.

n \ k	k		
	1	3	5
3	0.7208	0.6167	0.5500
50	0.9333	0.8583	0.7750
159	0.9416	0.8291	0.7583

3-fold cross-validation accuracy

我們選擇達成最佳的 3-fold cross-validation accuracy 的參數 $(k, n) = (1, 159)$, 並在 test set 上做測試。最終得到 test set 的 recognition rate 為 0.9437。