Deep Learning for Computer Vision

Homework1

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Problem 1: Bayes Decision Rule

A:

$$P(x|\omega_1) = \frac{1}{5}, when\ \ 0 < x < 5$$

$$P(x|\omega_2) = \frac{1}{3}, when\ \ 3 < x < 6$$

$$P(\omega_1) = \frac{3}{4}, \qquad P(\omega_2) = \frac{1}{4}$$

$$P(x|\omega_1) \cdot P(\omega_1) = \frac{3}{20}$$

$$P(x|\omega_2) \cdot P(\omega_2) = \frac{1}{12}$$

$$P(x|\omega_1) \cdot P(\omega_1) > P(x|\omega_2) \cdot P(\omega_2), when\ \ 3 < x < 5$$

Thus, error will occur when $3 < x < 5$ and ω_2 was classified as ω_1,

$$P_e = \int_3^5 P(error|x)P(x)\,dx$$

$$= \int_3^5 P(x|\omega_2)P(\omega_2)dx = \frac{1}{6}$$

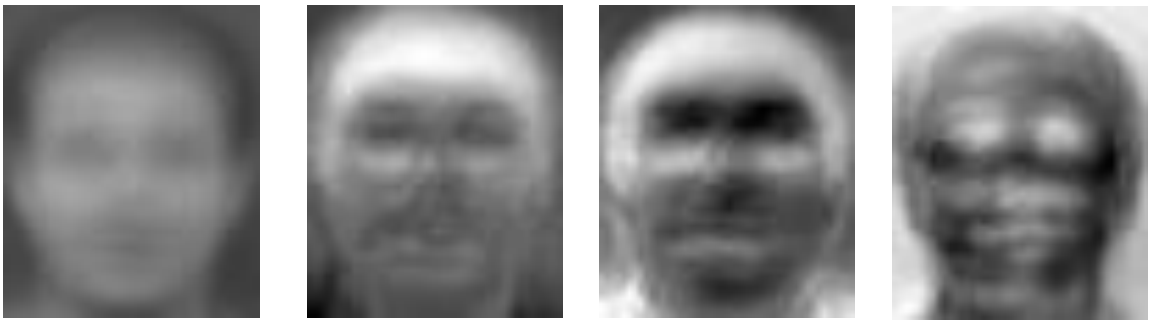
$$R_1 \rightarrow (0,5)$$
$$R_2 \rightarrow (5,6)$$

Problem 2: Principal Component Analysis and k-Nearest Neighbors Classification

A:

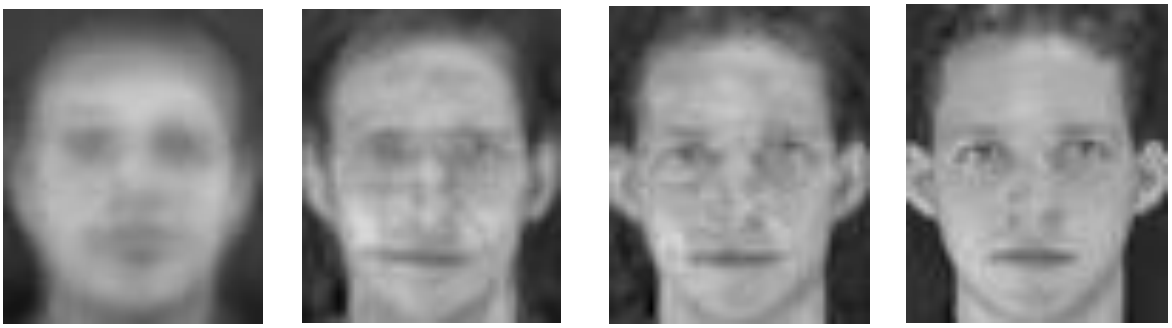
(a) Plot the mean face and the first three eigenfaces.

Mean Face | Eigenface 1 | Eigenface 2 | Eigenface 3



(b) Plot the reconstructed images with n = 3, 50, 100, 239 with the corresponding MSE values.

n = 3 | n = 50 | n = 100 | n = 239



MSE: 659.407 | MSE: 213.263 | MSE: 81.952 | MSE:2.877 e-26

(c) Please show the cross-validation results and explain your choice for (k; n). Finally, use your hyperparamter choice to report the recognition rate on the test set.

The following forum is the accuracy on the validation set with different (k; n), and they are the average accuracy of 3-fold cross-validation.

k \ n	3	50	159
1	68.75%	88.75%	91.25%
3	55.42%	77.91%	65.42%
5	50.42%	70.42%	67.92%

With larger **n**, we can describe a face more accurately, as it having more details. However, if the **k** increases, possible candidates might affect our accuracy as noise data. Thus, I chose (k; n) = (1, 159) as my hyperparamter to do the classification on the test set. The result is 73.75%