

# Intelligent Computing and Machine Learning

Lecturer: Min-Chun Hu 胡敏君

Homework 3: Dimension Reduction

**Deadline: 11/19 pm 10:00**

# Homework 3-A

- Apply PCA (Principal Component Analysis) to the MNIST database of hand written digits and write a report to analyze the characteristics of each main axis in the reduced 2D-space.
- MNIST data set:
  - train-images.idx3-ubyte
  - <http://yann.lecun.com/exdb/mnist/>



# Homework 3-A (Cont.)

- ❑ Bonus : Apply ICA and LLE to the same dataset and compare the results with PCA
- ❑ The submitted file should contain
  1. Source code
  2. A report including:
    - Brief description of development environment
    - The result figure as the example in page 2
    - Description of your observations
    - Any comment that helps the TA to understand/run your code
- ❑ Zip all of your files into one and name it as :  
**ML2018\_HW3A\_StudentID\_Name.zip**

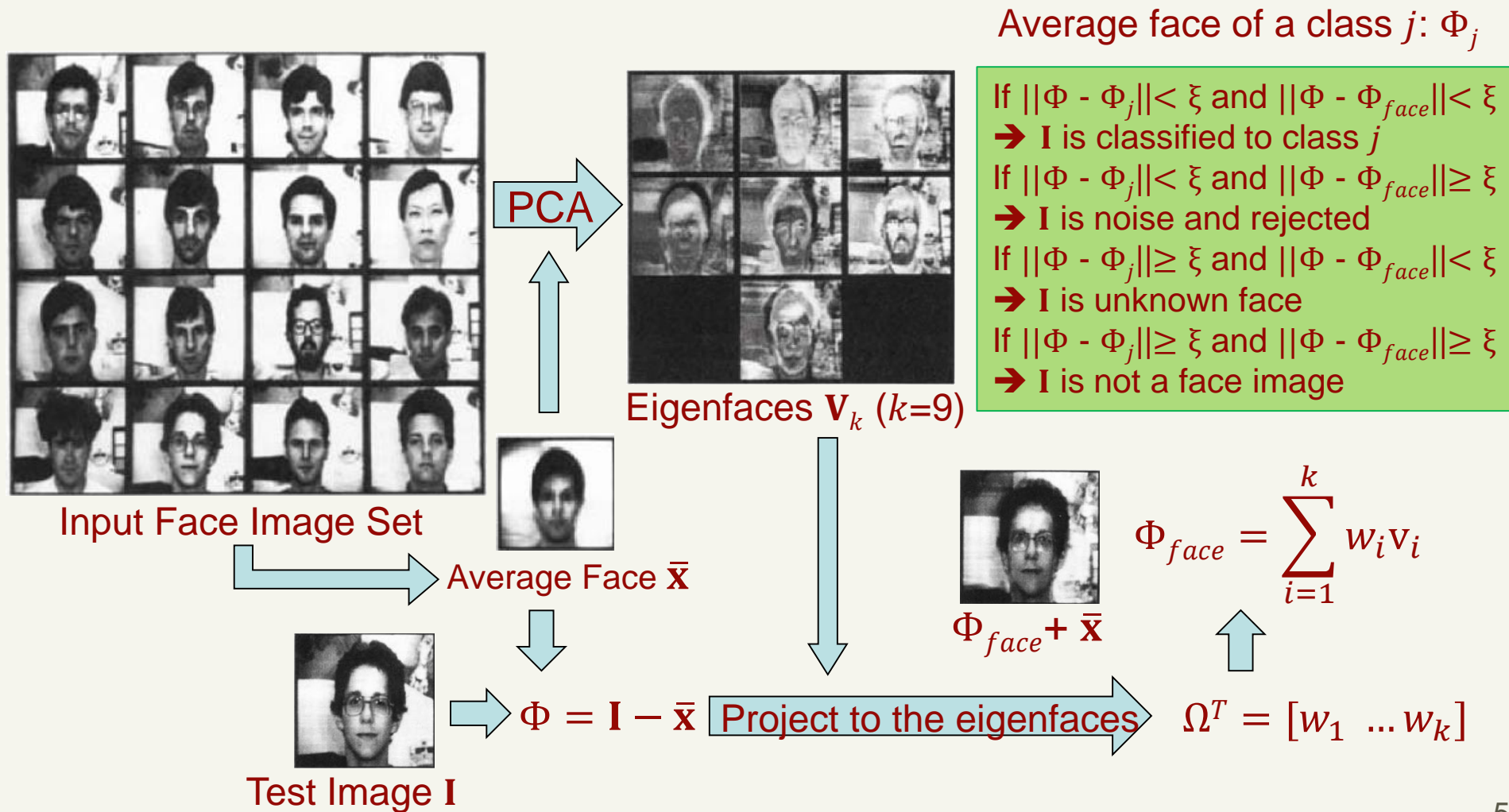
# Homework 3-B

- Implement the eigenface algorithm (cf. page5) using the train.db database and do the following tasks.
  1. Show the mean (average) face, top 5 eigenfaces and their corresponding eigenvalues in a descending order.
  2. Given a test image (hw03-test.tif, or you can use your own image), compute the top 10 eigenface coefficients.
  3. Keep only first K (K=5,10,15,20, and 25) coefficients and use them to reconstruct the image in the pixel domain. Compare the reconstructed image with the original image by PSNR (Peak Signal to Noise Ration) value.

$$MSE = \frac{1}{MN} \sum_{y=1}^M \sum_{x=1}^N [I(x, y) - I'(x, y)]^2$$

$$PSNR = 20 \cdot \log_{10} \frac{255}{MSE^{\frac{1}{2}}}$$

# Homework 3-B (Cont.)



# Homework 3-B (Cont.)

- ❑ The submitted file should contain
  1. Source code
  2. A report including:
    - Brief description of development environment
    - The results of task 1~3 described in page 4
    - Description of your observations
    - Any comment that helps the TA to understand/run your code
- ❑ Zip all of your files into one and name it as :  
**ML2018\_HW3B\_StudentID\_Name.zip**