



KNN ALGORITHM FOR HUMAN FACE RECOGNITION

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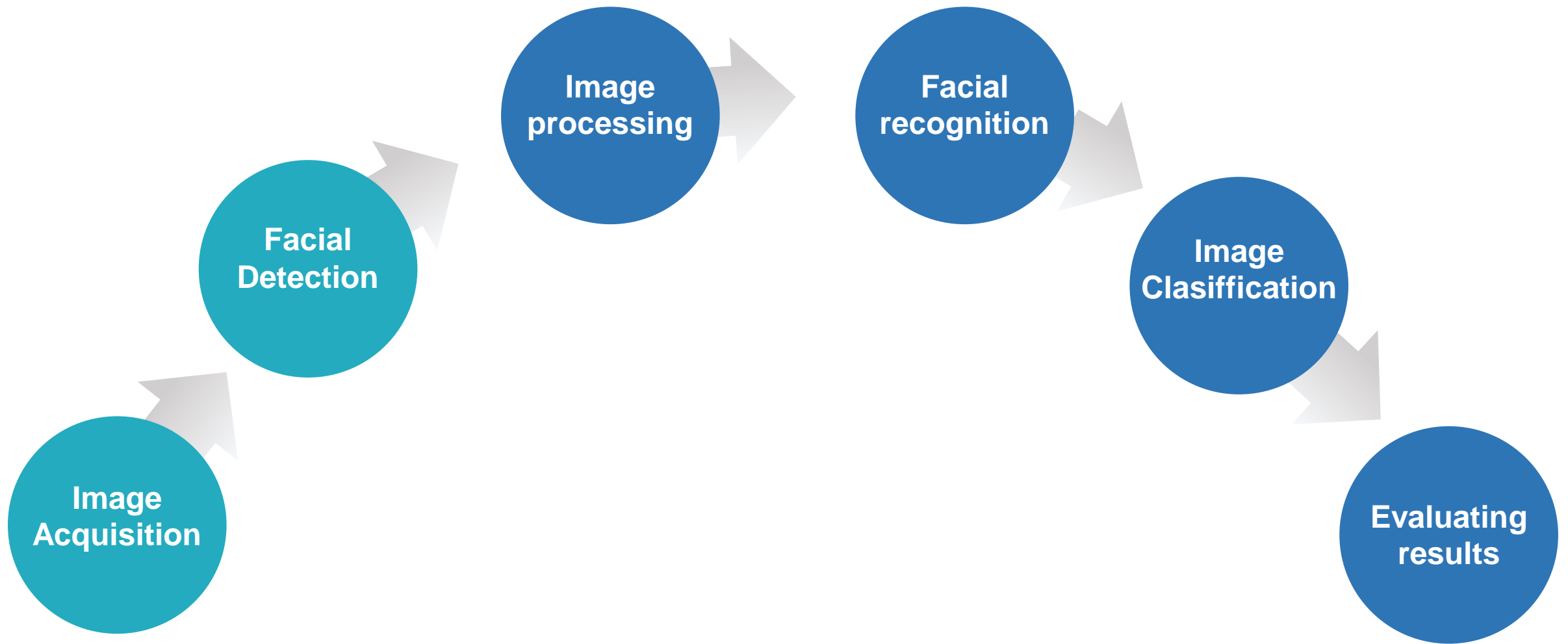
Course: Data Analysis

Semester: 4. Semester

PROJECT AIM

Creating a tool which recognizes faces
in different lighting conditions

Taking Facial Recognition Step by Step...



Dividing the Dataset

- Set of 2535 images of 39 subjects -> 65 images per person
- All greyscale (pgm) images under different light conditions
- Size: 168 x 192 pixel

65 images per person

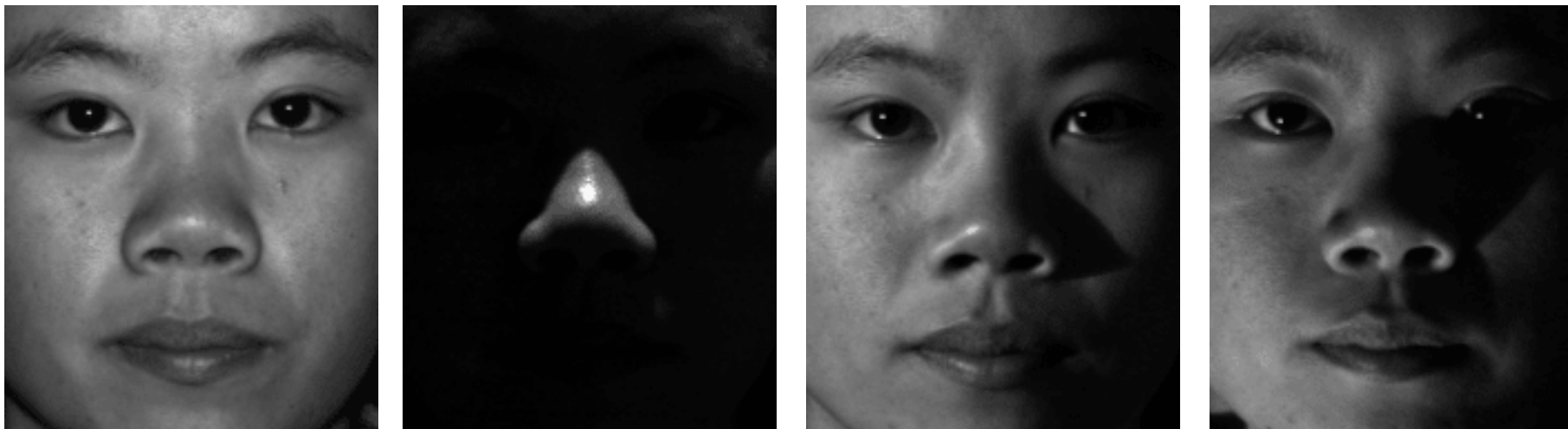
50 images for training


15 images for testing





Image Acquisition: Our Dataset

~ Extended Yale Face Database B ~



 yaleB37_P00A+000E+00.png

 yaleB37_P00A+000E+90.png

 yaleB37_P00A+050E+00.png

 yaleB37_P00A+050E-40.png

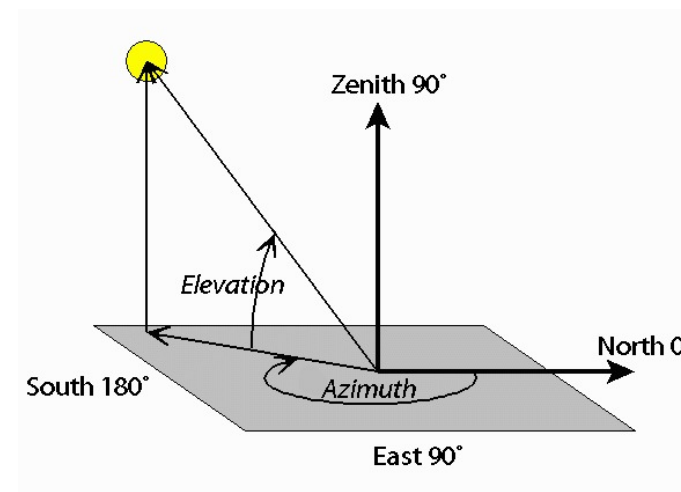
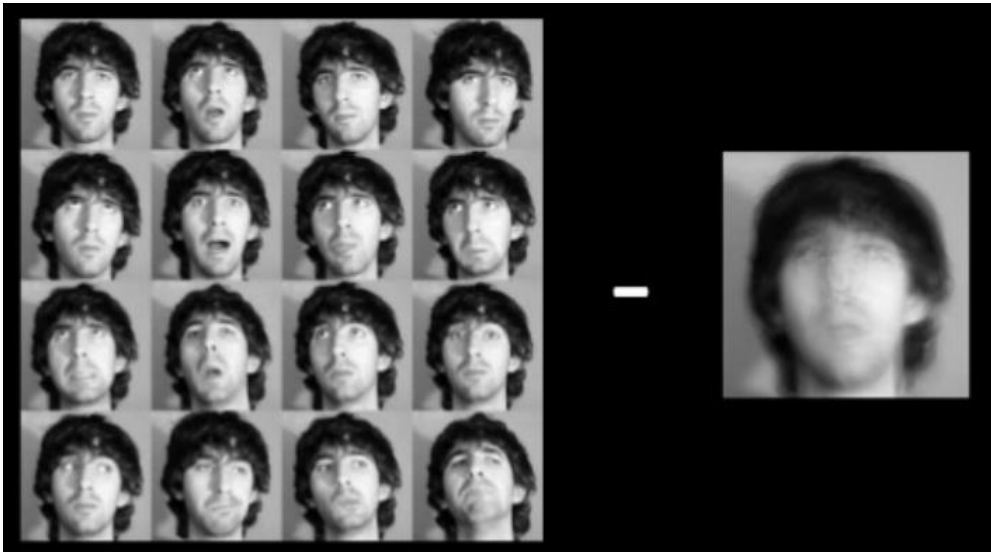
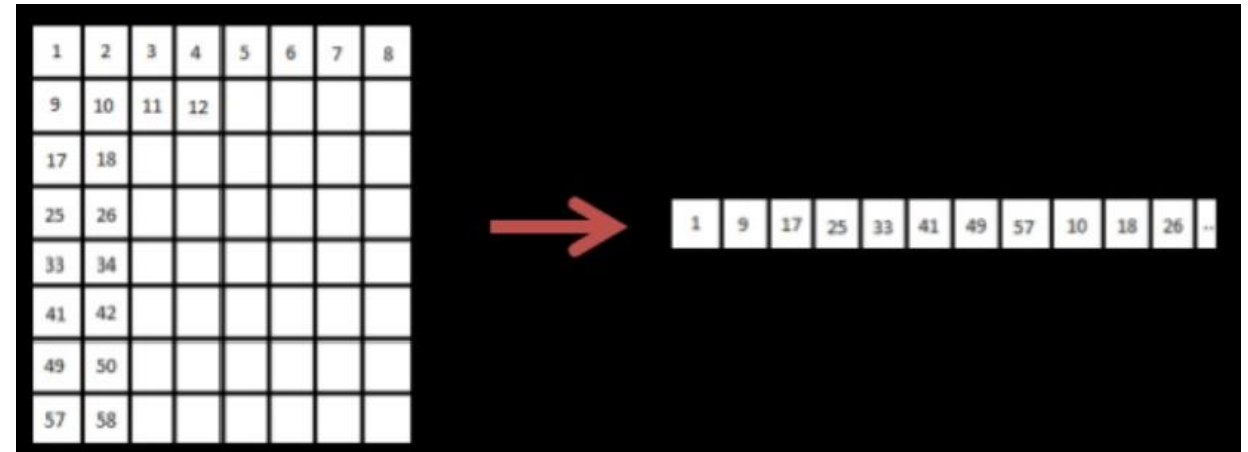


Image Processing

IMAGE SEGMENTATION:

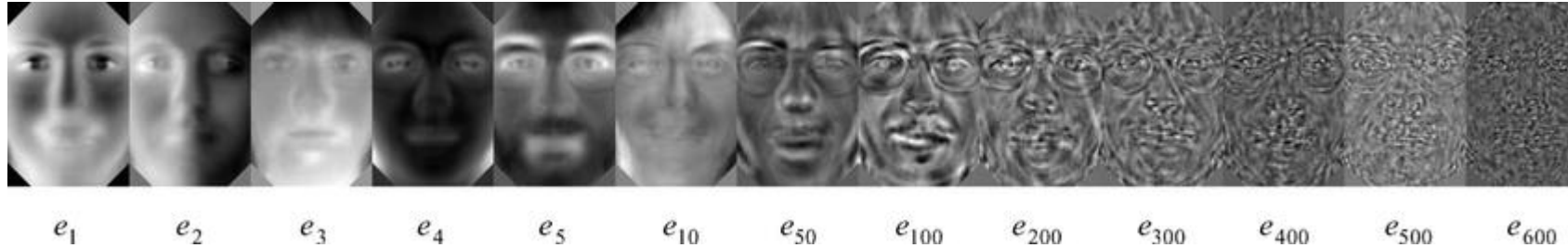
- Flattening the image into a vector
- Making an array using the vectors



MEAN FACE EXTRACTION:

- Image centering
- Data normalization
- Reducing the effect variant illumination

Feature Extraction Using PCA



PCA (Principal Component Analysis)

- Providing a lower dimensional picture
- Calculates eigenvectors (v_i) of the covariance matrix (S)
- Extracts the features of a face (eyes, nose, etc)
- Making a template out of them
- Reducing noise
- Creating eigenfaces which look like shadows of the original picture

$$Sv_i = TT^t v_i = \lambda_i v_i$$

Feature Extraction Using PCA

The images of the training dataset are converted into the PCA space by subtracting the mean image from each of them and multiplying the result by the eigenfaces matrix.

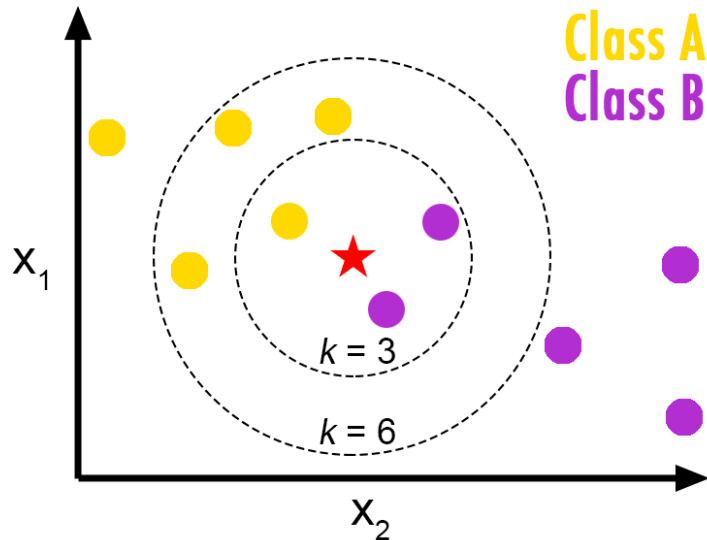
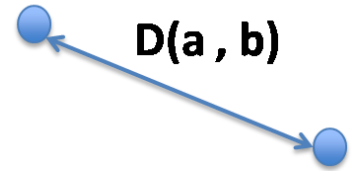
Input image from the testing dataset is converted into the PCA space by subtracting the mean image from multiplying the result by the eigenfaces matrix.



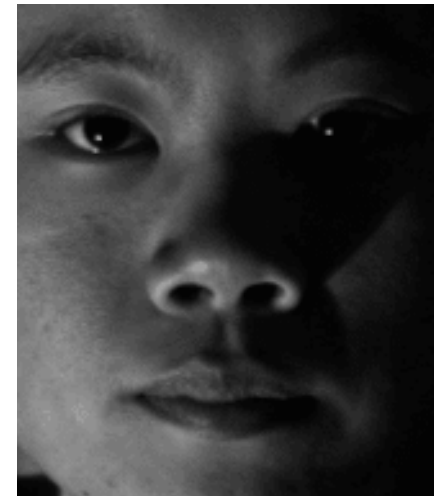
Validation Using KNN (K-Nearest Neighbors)

- Comparing the input image with the ones in the dataset
- Measuring the Euclidian distance between the pixels of different pictures
- Creating a distance matrix
- Assigning the new objects to the category of their most similar K nearest neighbors.

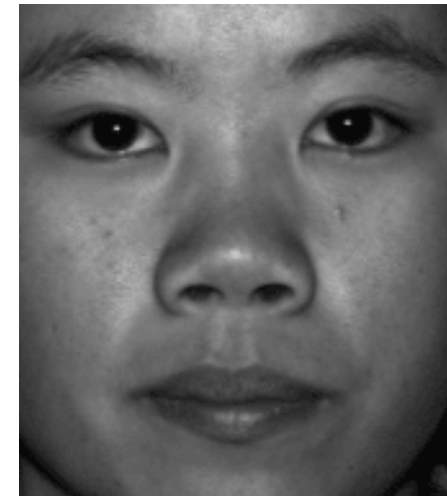
$$D(a, b) = \sqrt{\sum_{i=1}^n (b_i - a_i)^2}$$



Input image



Output image



Evaluating results (accuracy formula)

The performance of the system is measured in terms of accuracy:

$$\text{Accuracy} = \frac{\text{Correctly Detected Test Images}}{\text{Total Number of Test Images}}$$



Milestones and Deliverables

Segmenting the images into vectors and presenting them into a matrix

➡ Result : matrix of all the training set of images with all 39 participants

Extraction of a mean face

➡ Result: visual representation of the mean face

Calculating the covariance matrix and its eigenvalues and eigenvectors (the PCA)

➡ Result: Eigenfaces matrix

Milestones and Deliverables

Projecting training data and testing data onto the PCA subspace

 Result: transformed dataset matrix

Calculate Euclidian distance

 Result: Distance array

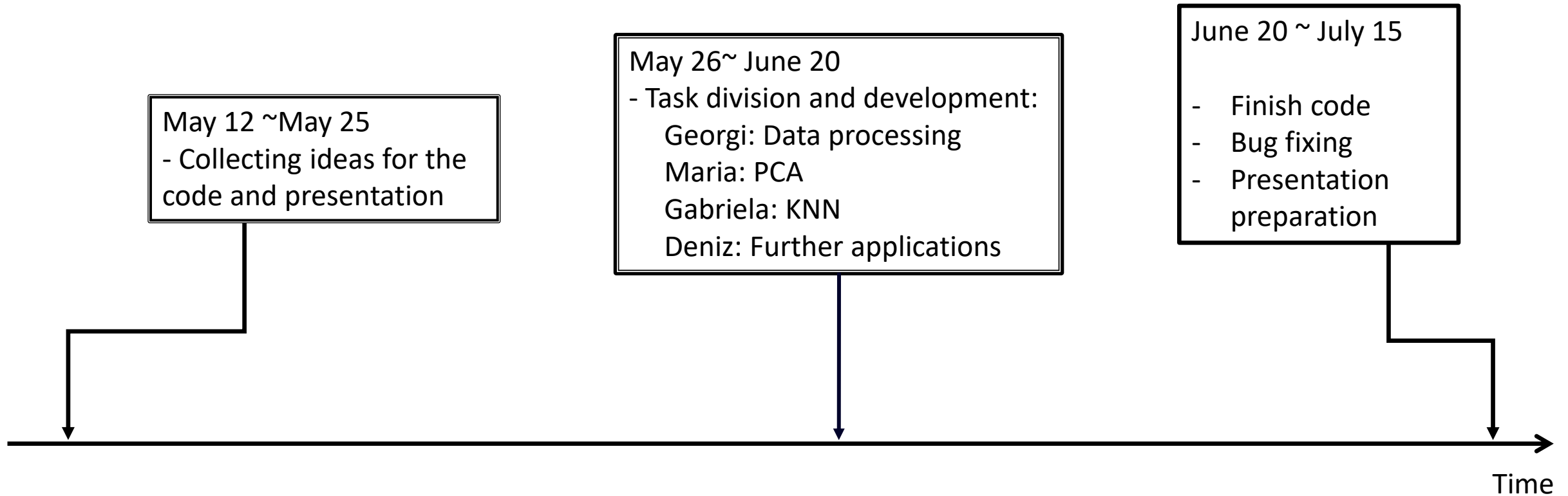
Grouping input image to images from training set using KNN

 Result: output image from training set

Further applications of KNN

- Taking the input image from a video or from a webcam
- Heart disease prediction
- Object recognition
- Detecting patterns in credit card usage
- Analyzing register data and detecting suspicious activity

Timeline



The background is a dark blue space filled with various geometric and digital elements. On the left, a glowing blue DNA double helix structure is visible. On the right, a wireframe face is constructed from blue lines and dots. Scattered throughout the scene are numerous small, colorful geometric shapes, including triangles, squares, and polygons in shades of green, yellow, purple, and blue. Some of these shapes appear to be floating or moving, creating a sense of dynamic digital activity.

Thank you for your
attention!

Sources

- Belhumeur, P.N., Hespanha, J.P. and Kriegman, D. "Eigenfaces vs. Fisherfaces: Recognition Using Class Specific Linear Projection." IEEE Transactions on Pattern Analysis and Machine Intelligence (1997), vol. 19, pp 711-720.
- Gerbrands, J.J. "On the relationships between SVD, KLT and PCA." Pattern Recognition (1981), vol. 14, issues 1-6, pp 375-381
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- Sasankar, P. and Kosarkar, U. "A study for Face Recognition Using Techniques PCA and KNN" Research Review Journals (2021)
- Wirdiani, N. et al. "Face Identification Based on K-Nearest Neighbor" Scientific Journal of Informatics (2019)