KNN ALGORITHM FOR HUMAN FACE RECOGNITION

Students: Maria Chiritescu, Gabriela Marinova, Georgi Georgiev, Deniz Akinbosoye

Tutor: Nicolas Peschke

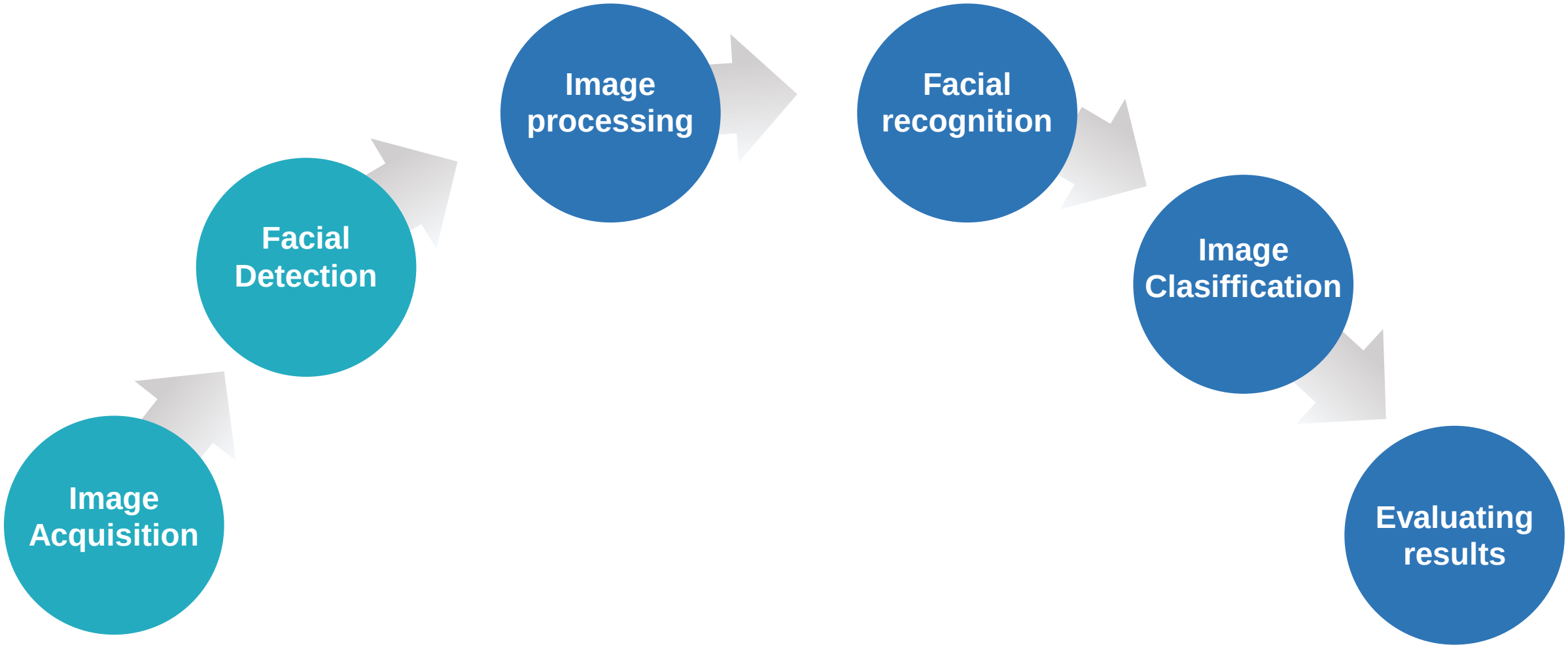
Course: Data Analysis

Semester: 4. Semester

PROJECT AIM

Creating a program which recognizes faces in different lighting and angles

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

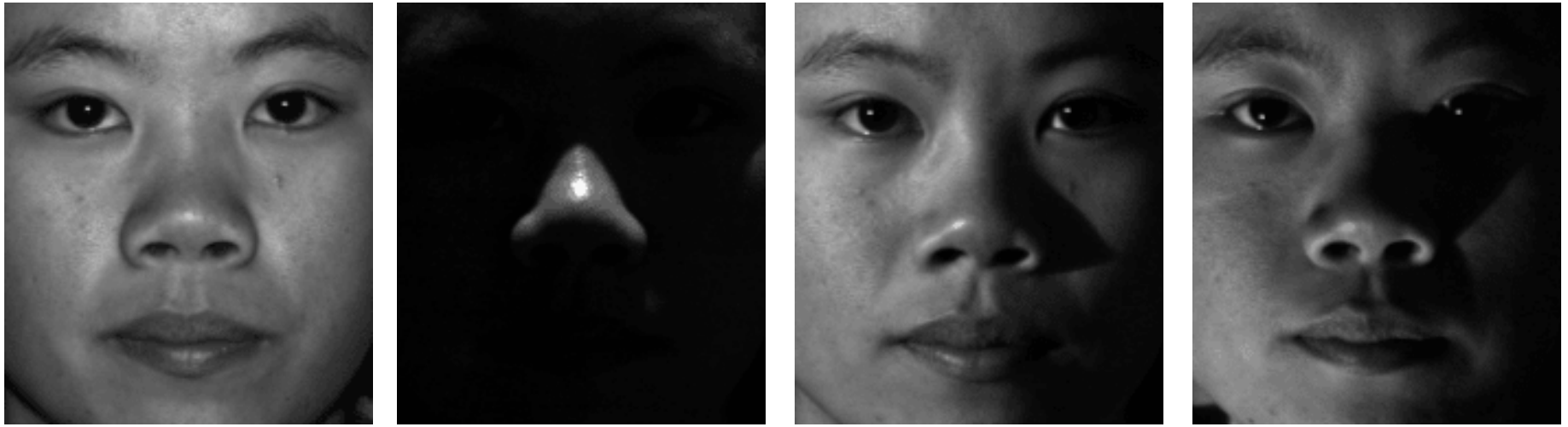
65 images per person

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

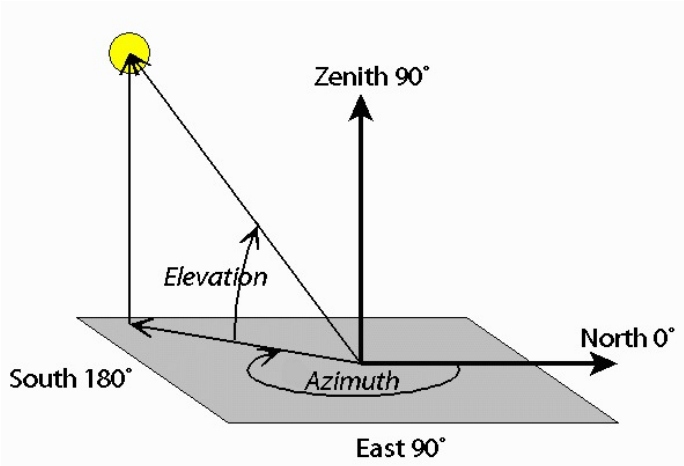
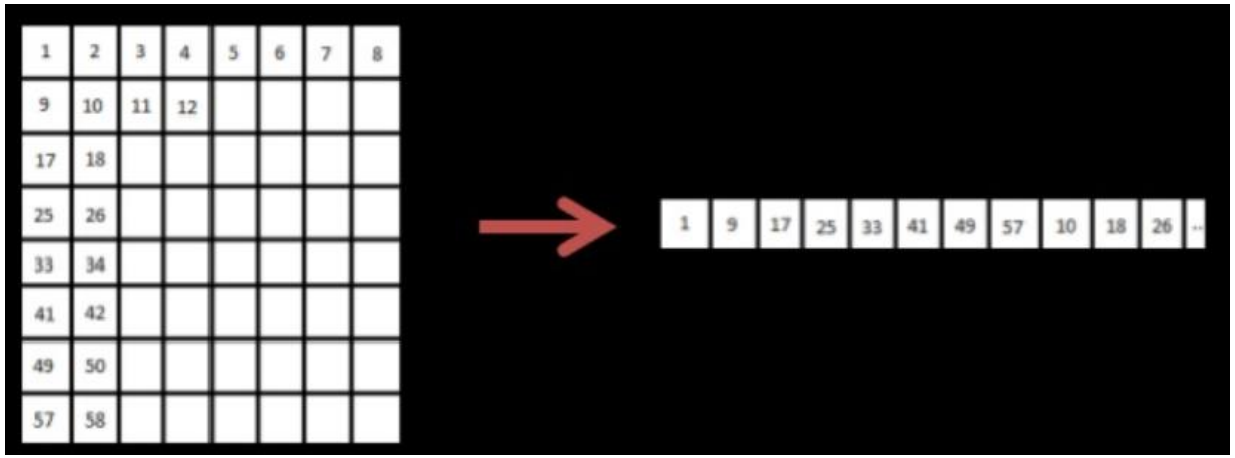
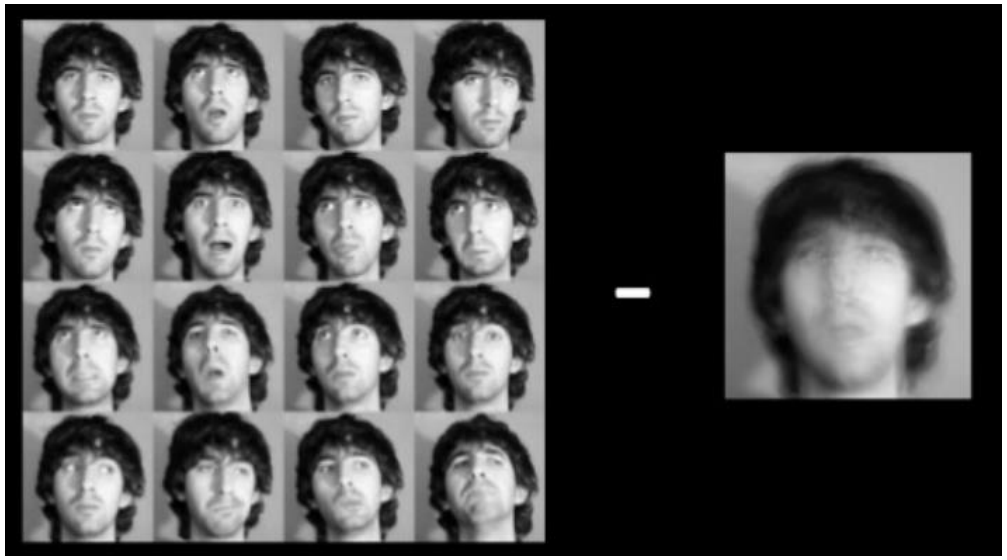


Image Processing

IMAGE SEGMENTATION:

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

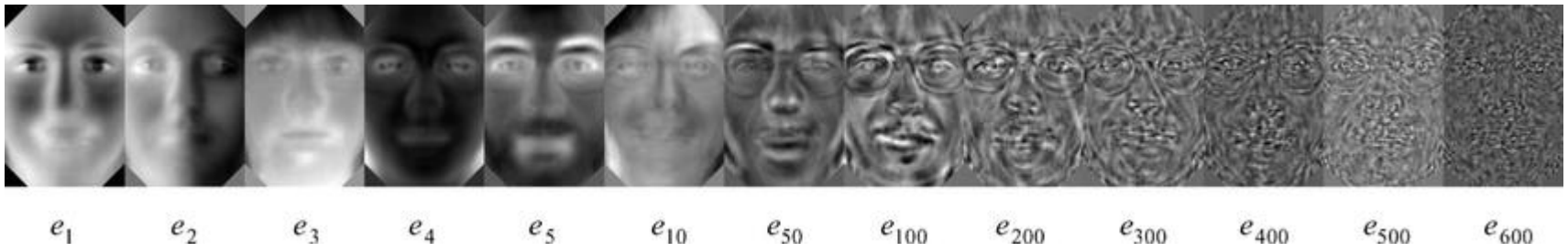




MEAN FACE EXTRACTION:

- 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

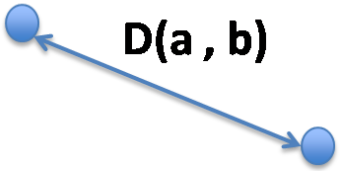
The images of the training dataset are converted into the PCA space by subtracting the mean image from each of them and multiplying the result by the eigenfaces matrix.

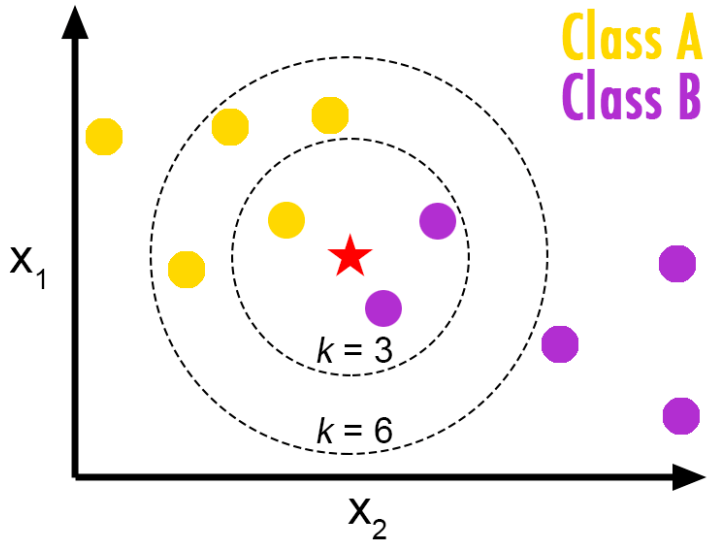
Input image from the testing dataset is converted into the PCA space by subtracting the mean image from multiplying the result by the eigenfaces matrix.

Validation Using KNN (K-Nearest Neighbors)

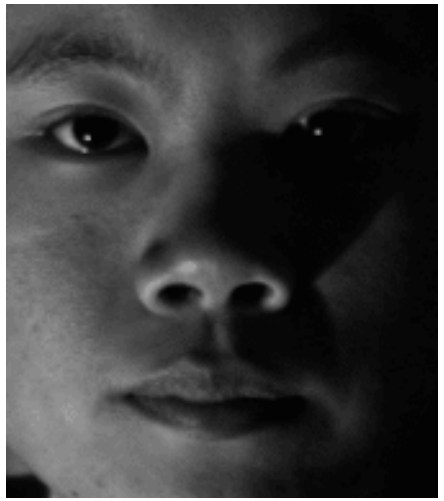
- Comparing the input image with the ones in the dataset
- Measuring the Euclidian distance between the pixels of different pictures
- Creating a distance matrix
- Assigning the new objects to the category of their most similar K nearest neighbors.

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

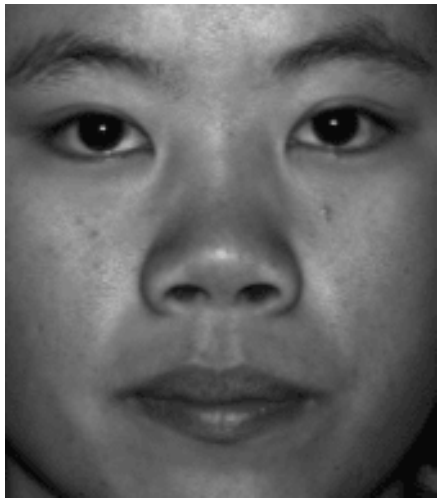




Input image



Output image



Evaluating results (accuracy formula)

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

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

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

Projecting centered training data into the PCA subspace

→ Result: transformed dataset matrix

Preparing testing data

→ Result: input images projected into the PCA subspace

Calculate Euclidian distance

→ Result: Distance array

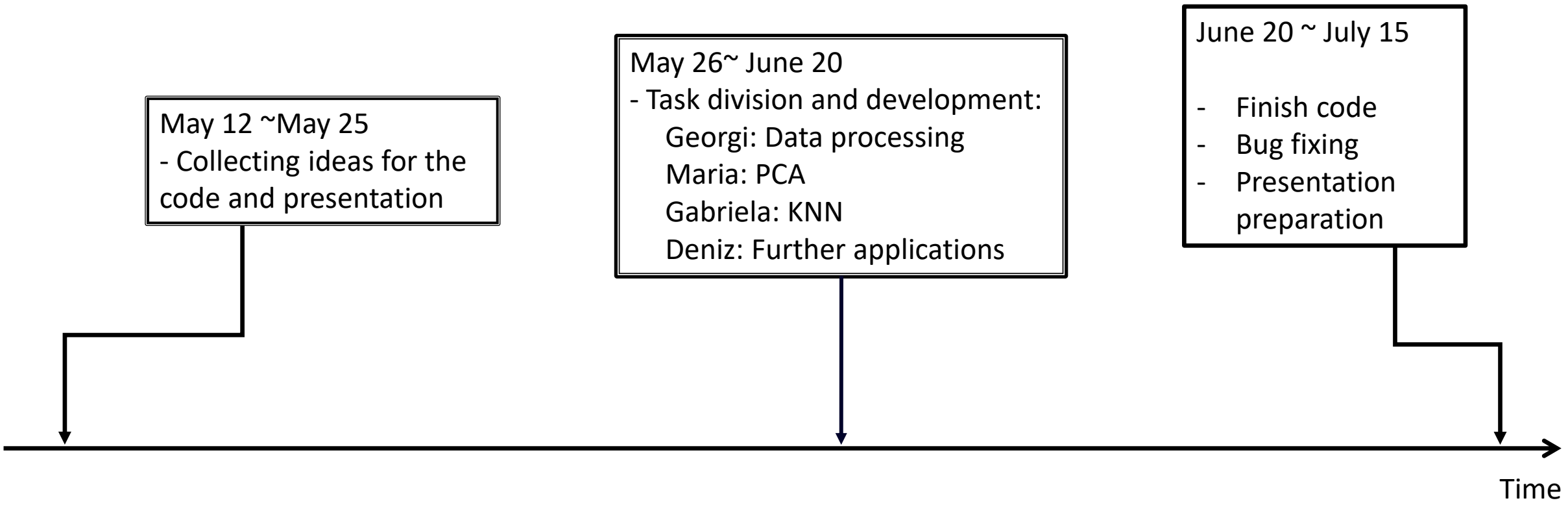
Grouping input image to images from training set using KNN

→ 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


May 12 ~May 25
- Collecting ideas for the code and presentation
May 26~ June 20
- Task division and development:
Georgi: Data processing
Maria: PCA
Gabriela: KNN
Deniz: Further applications
June 20 ~ July 15
- Finish code
- Bug fixing
- Presentation preparation
Time


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.

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