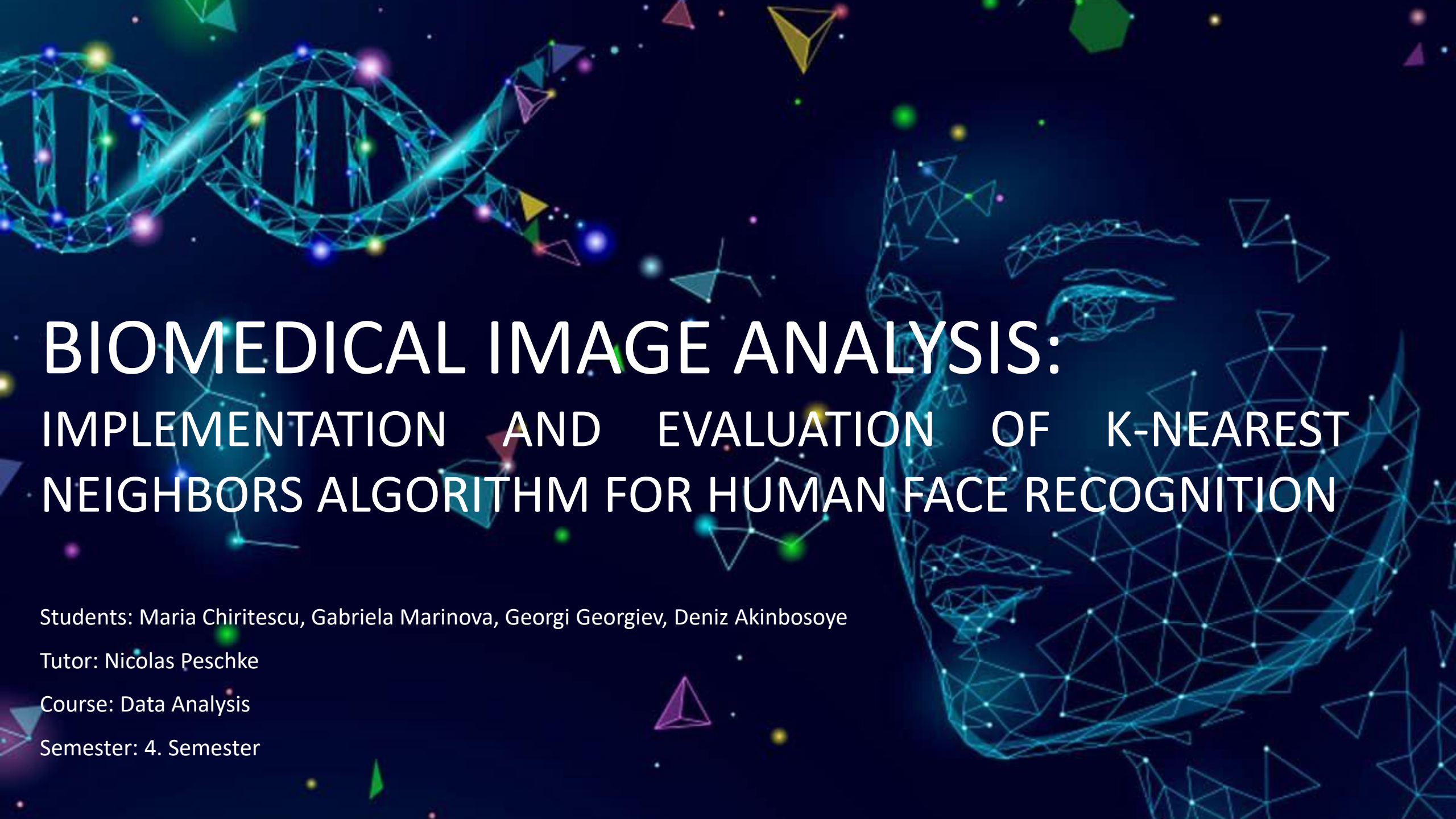

BIOMEDICAL IMAGE ANALYSIS:

IMPLEMENTATION AND EVALUATION OF K-NEAREST NEIGHBORS ALGORITHM FOR HUMAN FACE RECOGNITION

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Tutor: Nicolas Peschke

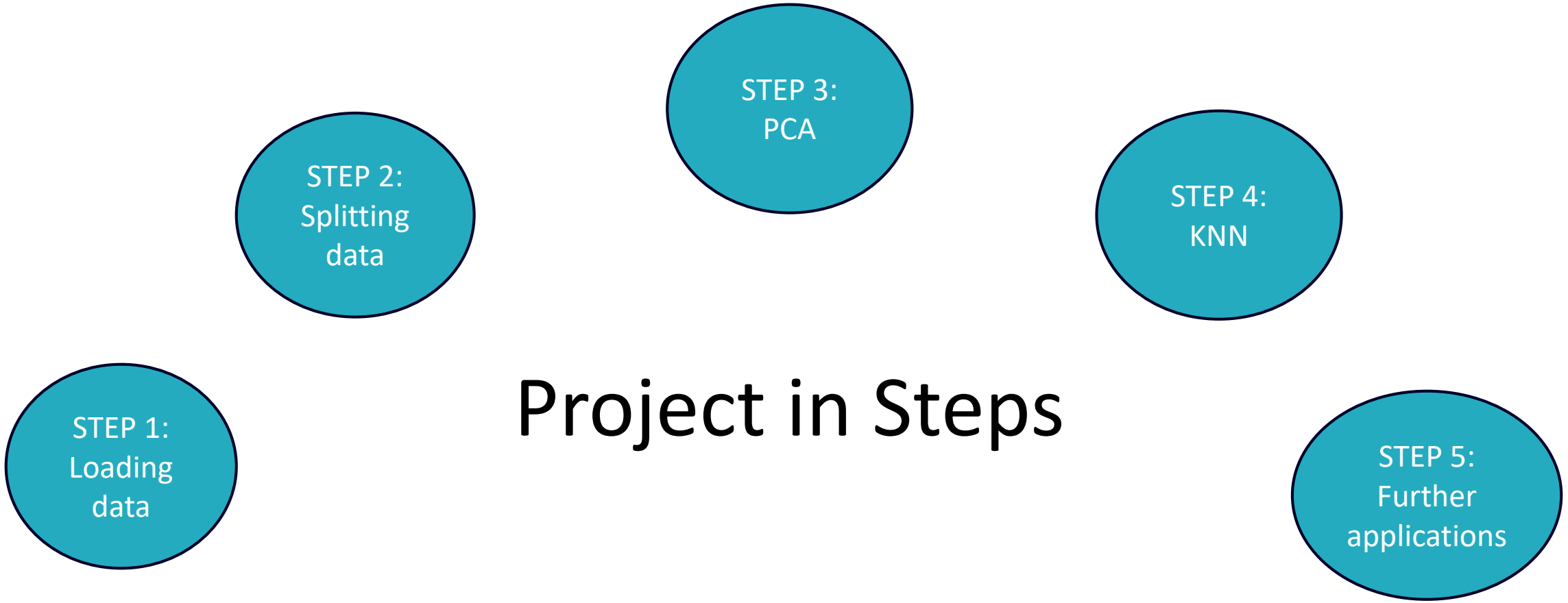
Course: Data Analysis

Semester: 4. Semester

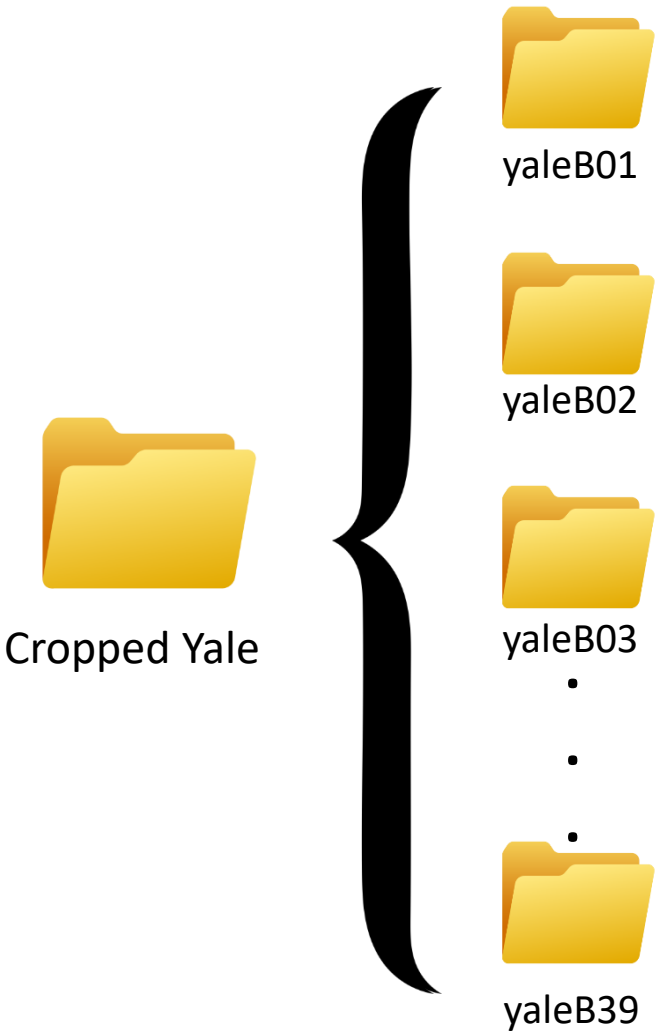
AIM OF THE PROJECT

Creating a program that recognizes faces in different lighting conditions

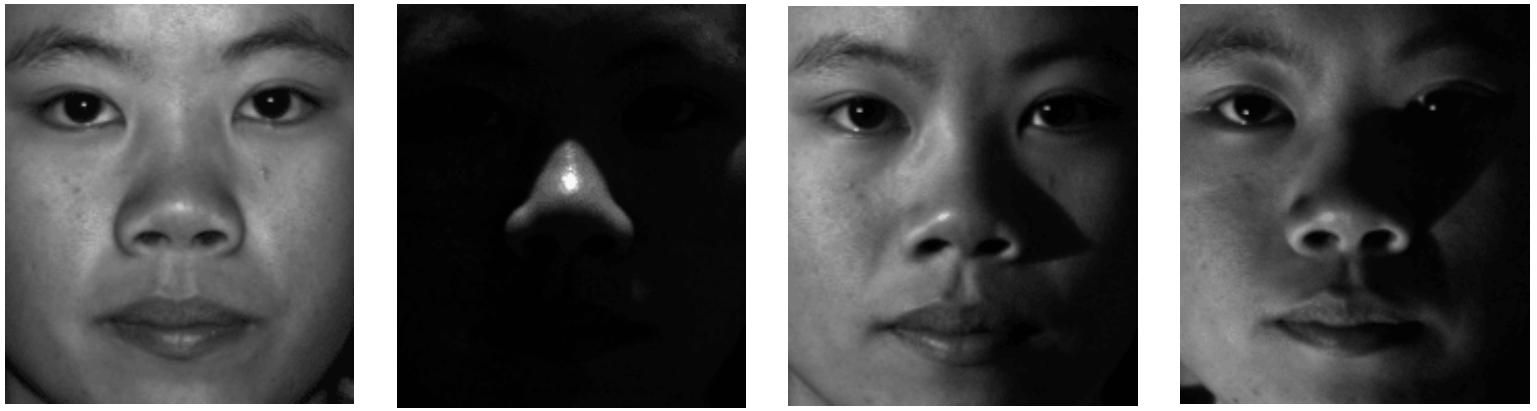
Project in Steps



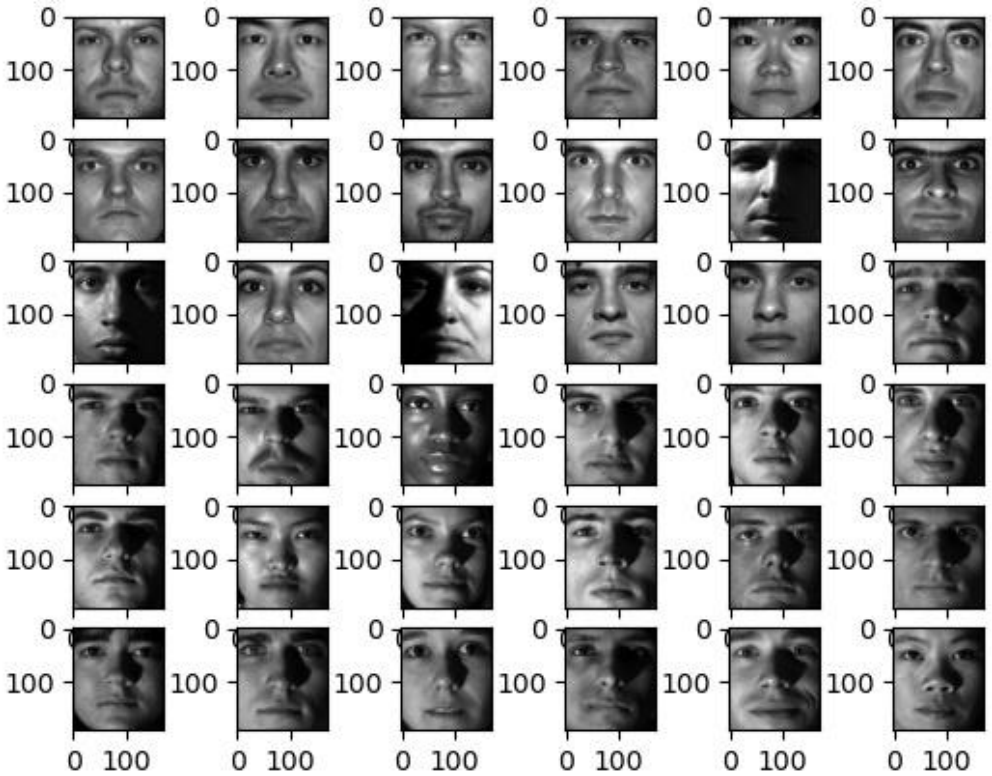
The Dataset



- Main folder “Cropped Yale” contains 39 subfolders;
- Each subfolder contains pictures of one single person => 39 people in total
- Subfolders are denoted “yaleB01”, “yaleB02”, …, “yaleB39”
- Subfolder “yaleB14” is missing => 38 people in total;
- Each subfolder contains 64 grayscale images of each person that the program analyses;
- The pictures in each subfolder differ in angles and illuminating conditions.



Dividing the Dataset

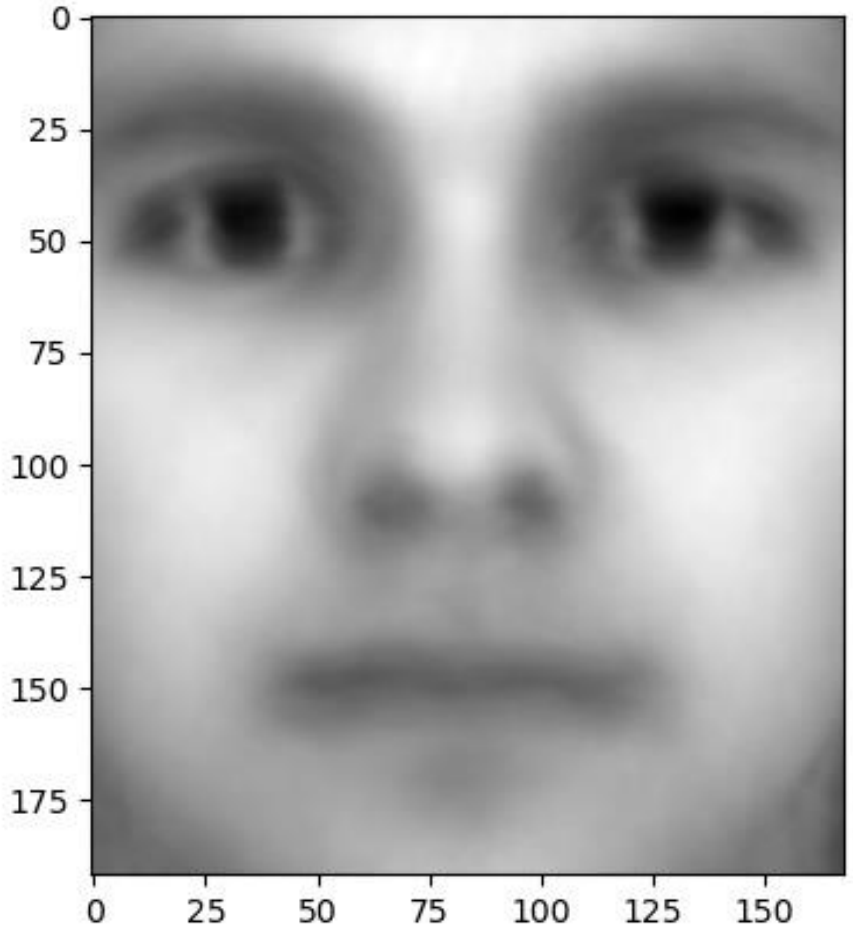


2414 images overall

80 % of the images for training set

20% of the images for the testing set

Mean Face



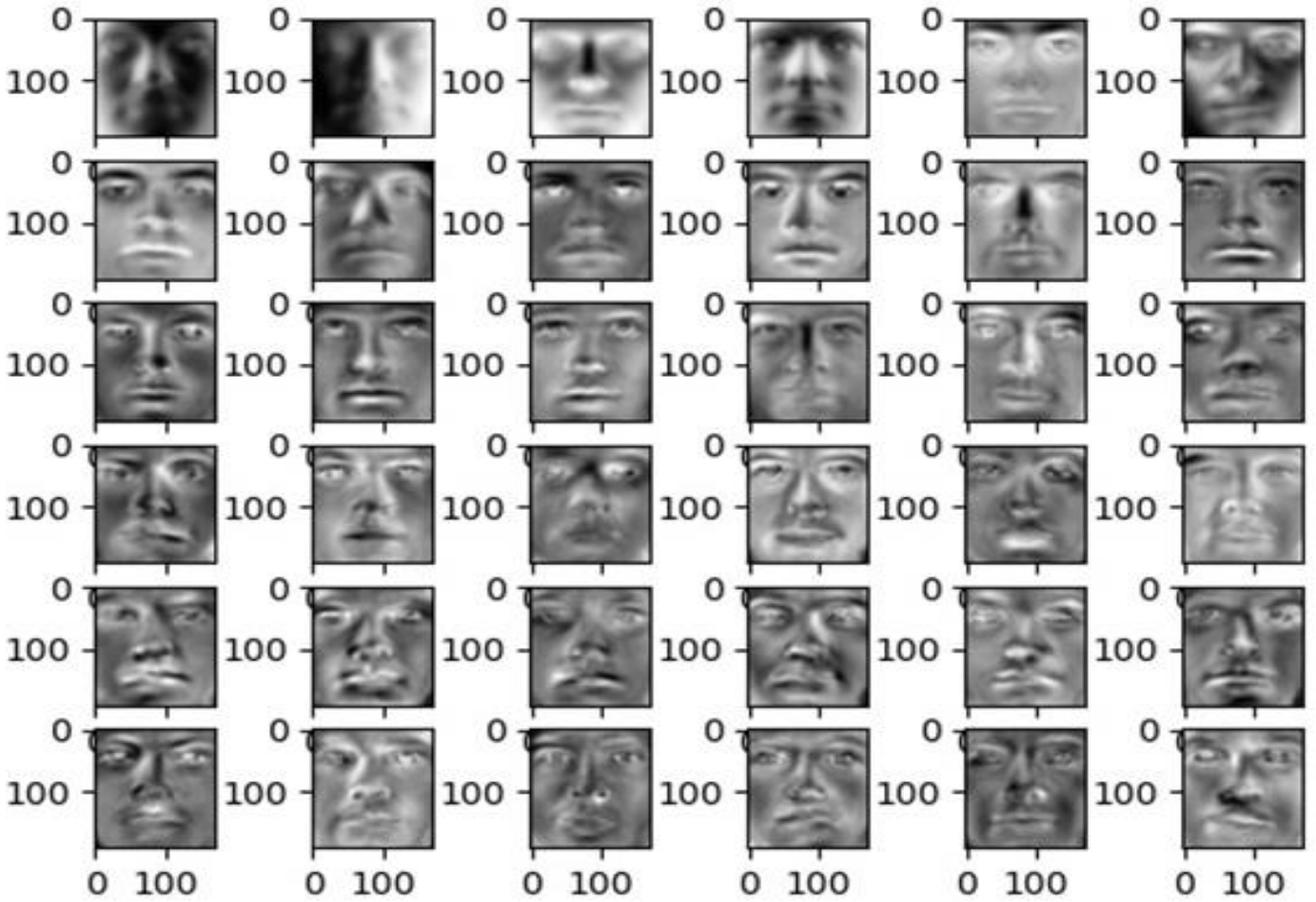
MEAN FACE EXTRACTION:

- Image centering;
- Allows the comparison of the images;
- After centering mean becomes zero.

Dimensionality-Reduction Using PCA

PCA (Principal Component Analysis):

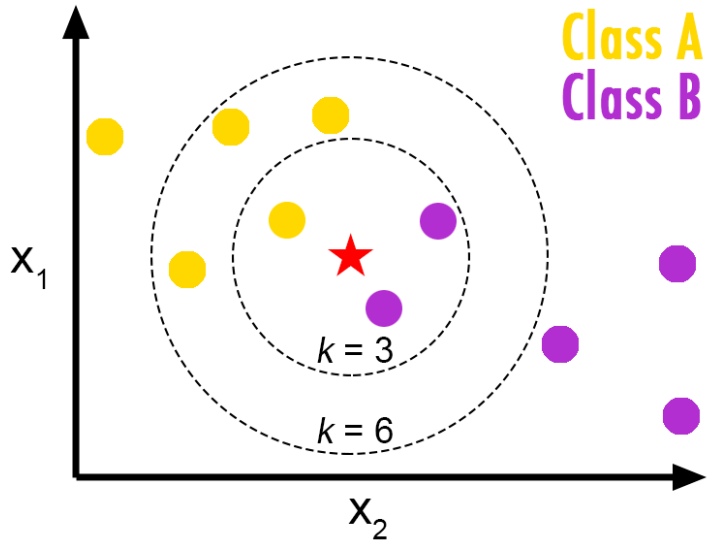
- number of principal components < number of pixels;
- Each variable in the original dataset can be represented in terms of principal components;
- result: dimension reduction.



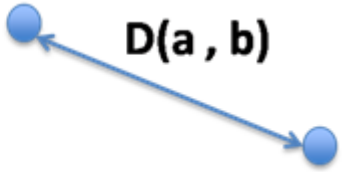
Classification Using KNN

KNN (K-Nearest Neighbors):

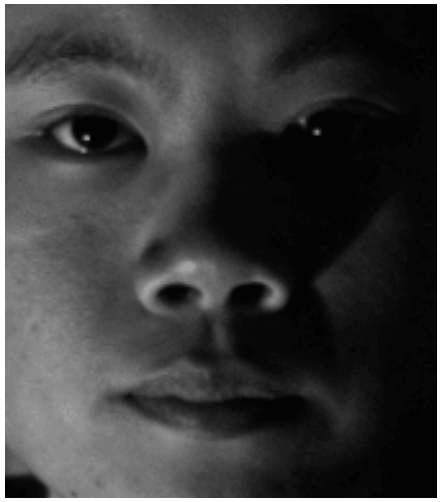
- compares the images from the testing with these in the training set;
- measures the Euclidian distance between the components of different pictures;
- assigns the new images to the labels of their most similar K nearest neighbors.



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



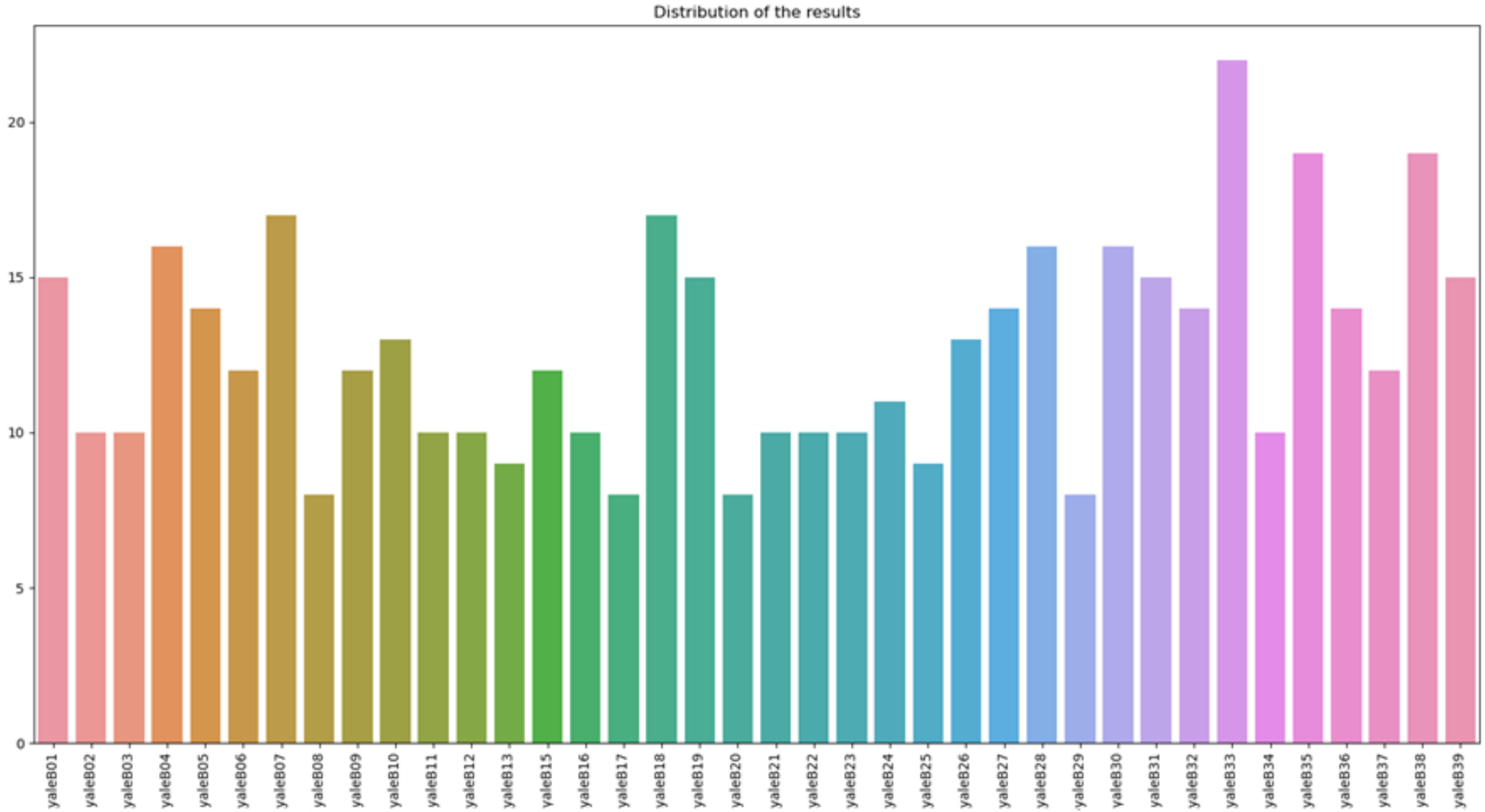
Input



Output

yaleB37

KNN Classifies Test Pictures Based on the Faces Recognized in Them

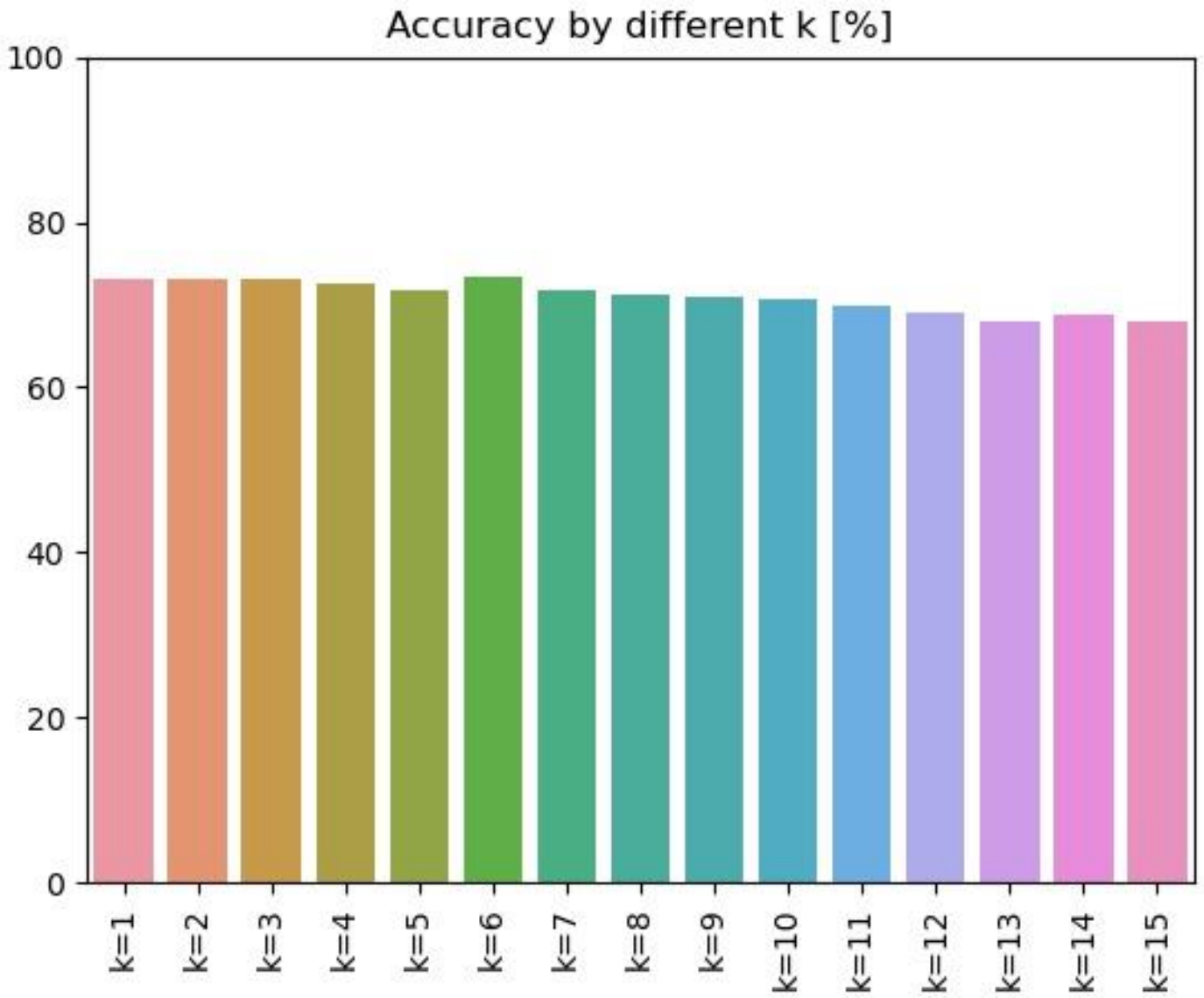


Evaluating the Results

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

$$Accuracy = \frac{Correctly\ Detected\ Test\ Images}{Total\ Number\ of\ Test\ Images} \text{x}100$$

Accuracy by Different k-Values



- In our case: the best accuracy appears for k = 6: 73.4989648033126%.

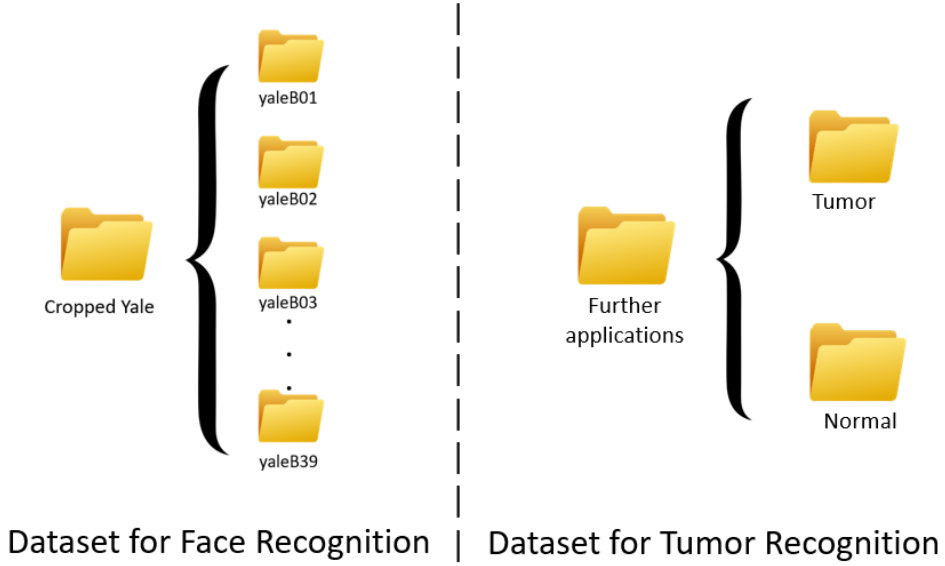
Further Applications of the Program

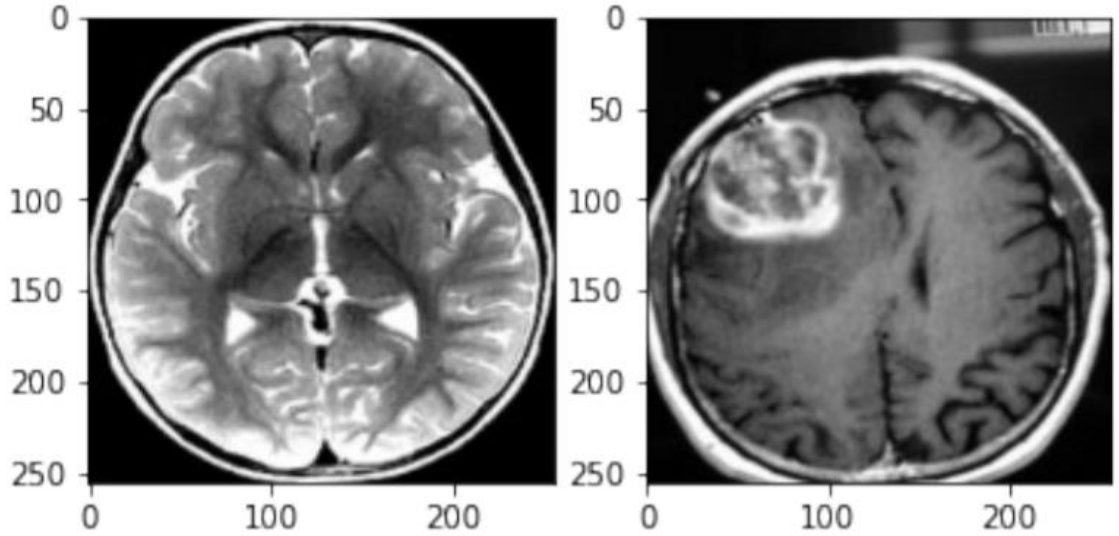
- The algorithm can match and sort newly given images of individuals with other images of the same person;
- Our algorithm is not limited to recognizing faces, but images of any kind, given there is a pattern at hand.

Examples of further applications of this program

- Taking the input image from a video or from a webcam;
- Detecting patterns in credit card usage;
- Analyzing register data and detecting suspicious activity.
- Object recognition;
- Diagnosing diseases;

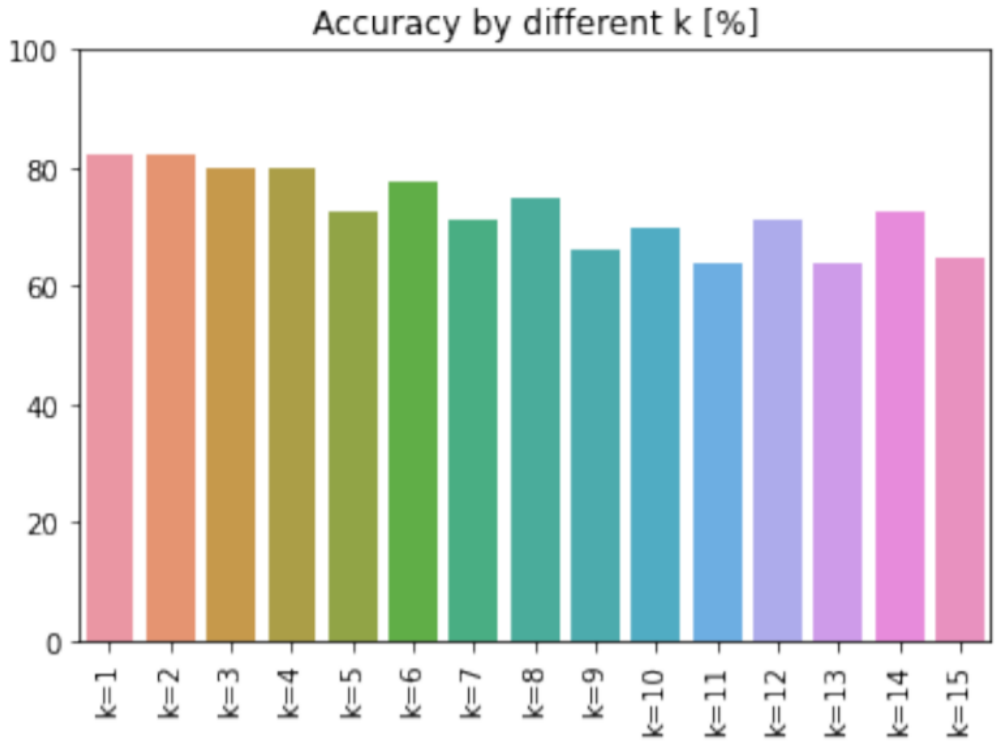
Further Application of the Program: Tumor Recognition

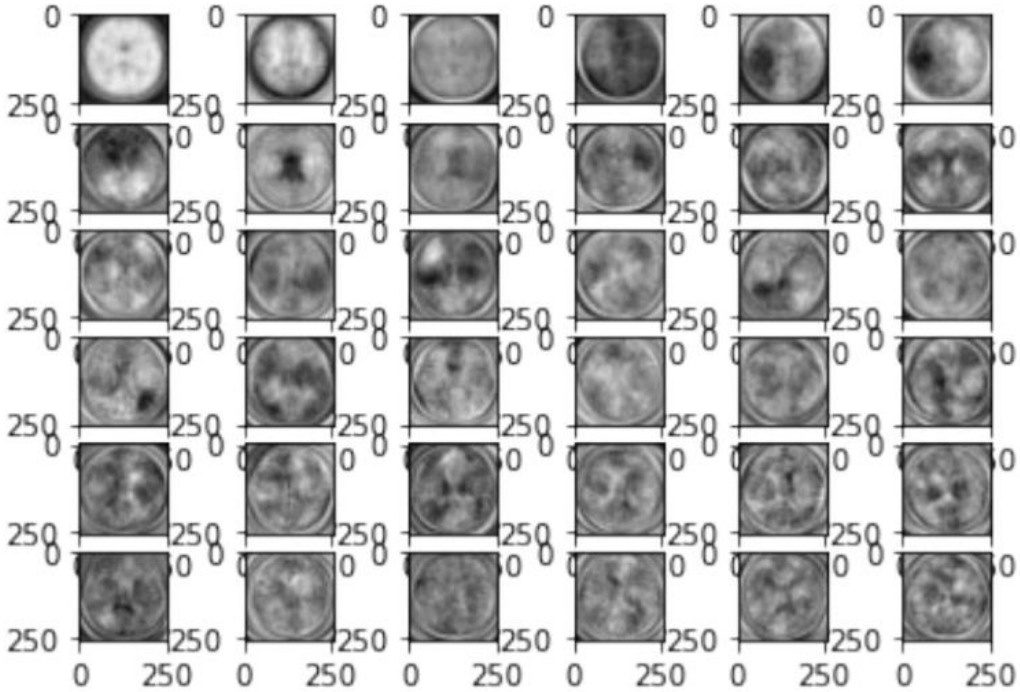




- Open-source folder of Brain magnetic resonance images (MRI) scans;
- Folder divided into 2 sub-folders: ‘Tumor’ and ‘Normal’;
- Algorithm altered to distinguish healthy and unhealthy brain images.

Results of Tumor Recognition





- Illustrating the accuracy of the results shows that working with a small k-value deliver more reliable results;
- The first graph shows the accuracy of different k values, the second shows the principle components;
- We see, lower k values give the most accurate results, k=2 is our maximum at around 82%;
- Our algorithm is more accurate for tumor recognition than face recognition.


Thank you for your attention!

Sources

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