Human face recognition

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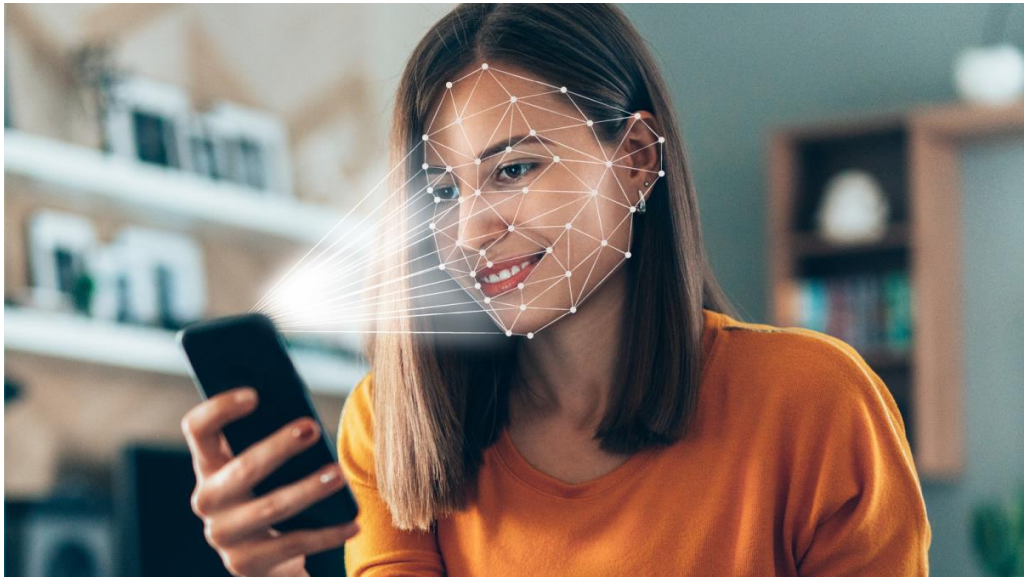
Supervisor: PD Dr. Karl Rohr, Dr. Leonid Kostrykin

What is human face recognition



A multitude of applications

➔ Face recognition used for:

- security systems
- authentication for banking, mobile phone
- law enforcement

[1+2]

Project aim

➔ Creating a program in python in order to identify each person

The data set

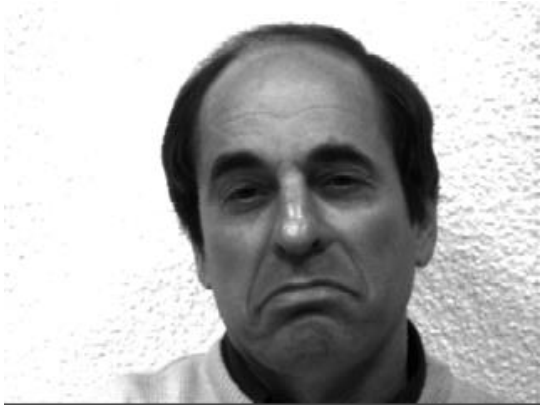
- ➔ Yale Face Database of human faces
- ➔ 165 images from 15 subjects - 11 images per subject
- ➔ GIF files
- ➔ grayscale images normalized by size (320x243 pixels)

The data set

➔ challenge: finding the best pattern, while…

The data set

emotion: sad



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z-transformation

DEFINITION

- before: picture ⇾ vector
- transforms discrete functions
- centering and scaling data

$$Z = \frac{X - \mu(X)}{\sigma(X)}$$

[3]

z-transformation

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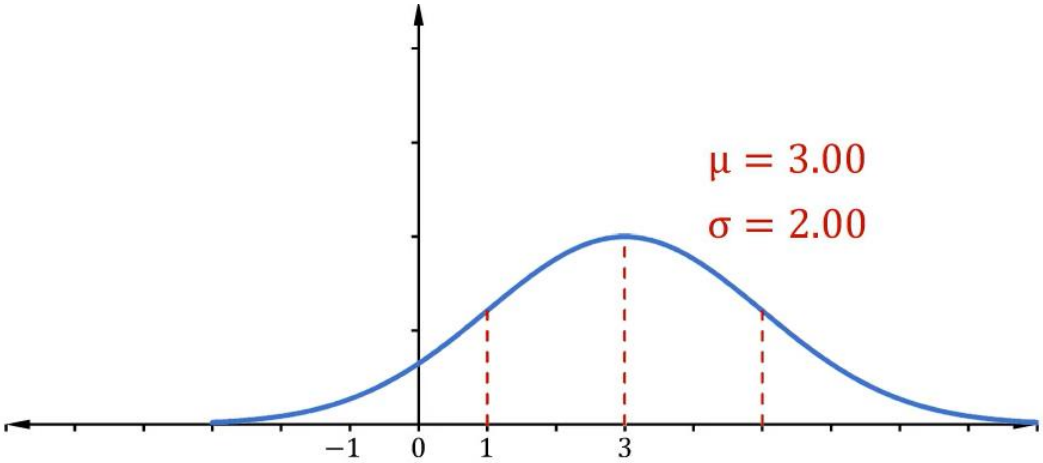

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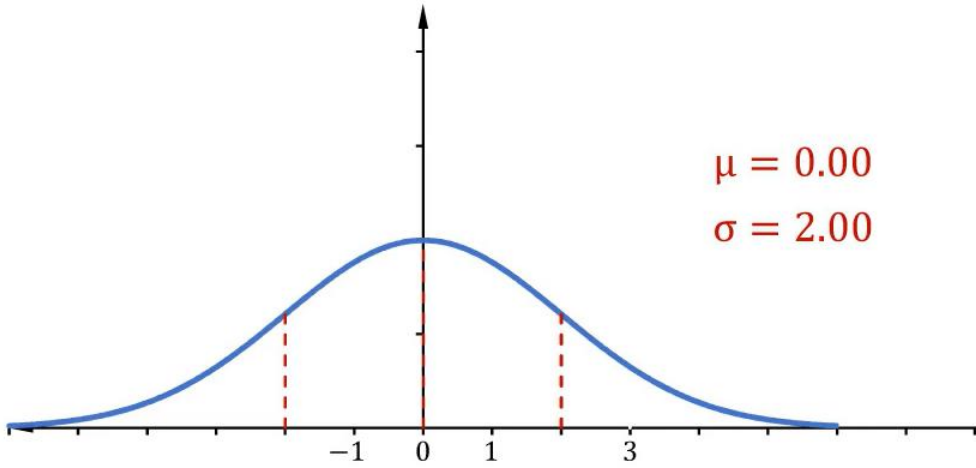

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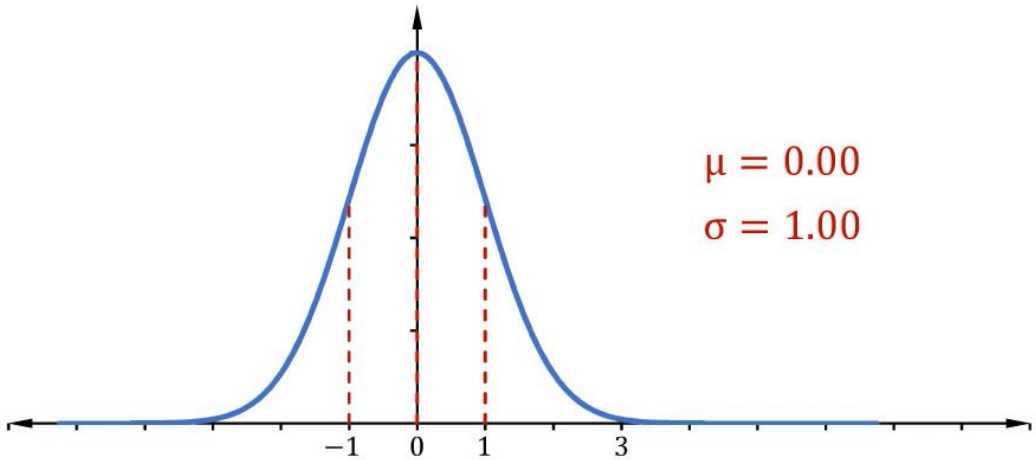

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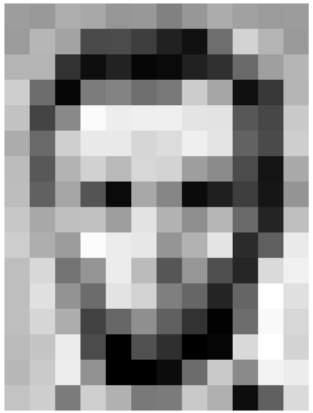
[3]

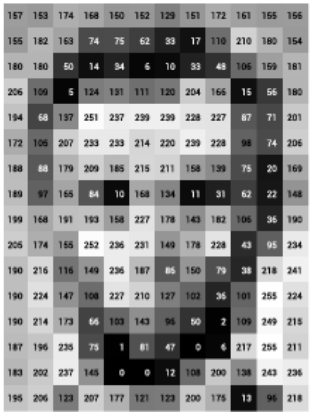
z-transformation

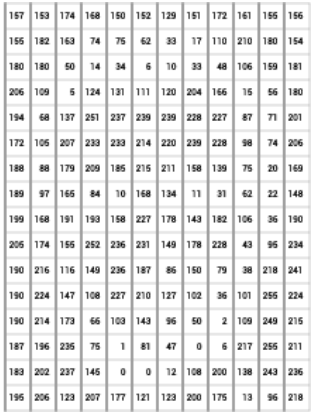
USE FOR US

- investigation of system properties
- basis for PCA

[4]







standardization of pixel values

PCA

MAIN GOAL: REDUCING DIMENSIONS TO MOST INFORMATIVE

- elimination of redundant covariance
- numbers of dimension: number of intensity values per picture

MEANING FOR PROJECT

- identifying most variable feature and removing it
  reducing dimension → program is faster

[5]

k-NN (k-nearest neighbors algorithm)

WHAT IS k-NN ALGORITHM?

- Classifies unknown data points by finding the most common class among k closest examples
- simple and effective for classification tasks
- k is a number of neighbors that will be considered
- k can be any integer number, chosen experimentally

k-NN (k-nearest neighbors algorithm)

k-NN ON IMAGE PROCESSING

- data points represent images of faces
- images to vectors of numbers
- searches images with closest face-features under euclidean distance
- facial landmarks are used as those features

k-NN (k-nearest neighbors algorithm)

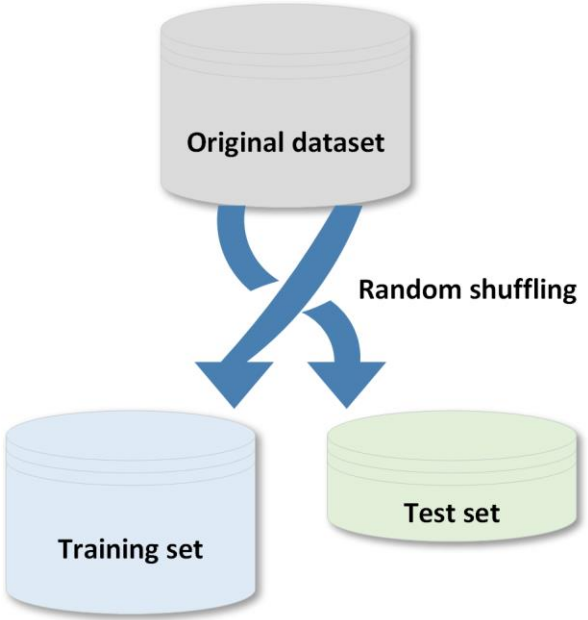
FACIAL LANDMARKS

[6]

k-NN (k-nearest neighbors algorithm)

k-NN FOR HUMAN FACE RECOGNITION

1. use our given dataset
2. split the dataset into training and testing set
3. training
4. testing



[7]

k-NN (k-nearest neighbors algorithm)

CHALLENGES USING k-NN

1. curse of dimensionality
2. imbalance classes
3. scalability
4. sensitivity to parameter k
5. feature quality

k-NN (k-nearest neighbors algorithm)

OTHER CLASSIFIERS

1. Support Vector Machines (SVMs)
2. Neuronal Networks (CNN)

k-NN (k-nearest neighbors algorithm)

BUT...

k-NN (k-nearest neighbors algorithm)

ADVANTAGES OF k-NN

- Non-parametric
- simple
- robust to noise
- interpretability

Additional Implementations

- LDA instead of PCA
- noise reduction at the beginning
- comparison with packages
- Other classifiers

Evaluation

accuracy: rightly detected images/ total number of images

comparison with other programs/ methods → time & accuracy

comparison accuracy of our program with state-of-the-art technology

timetable

Image preprocessing

Uploading pictures

Z – transformation

28th May

timetable

Image preprocessing

Uploading pictures

Z – transformation

28th May

May | June

Reducing dimensions

PCA

10th June

timetable

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Uploading pictures

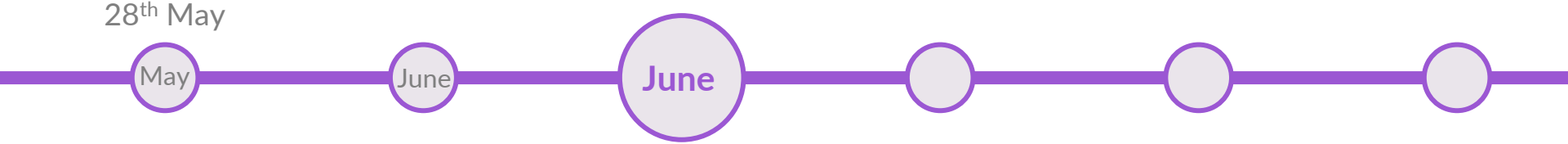
Z – transformation

28th May

Find nearest neighbors

k-NN

24th June



Reducing dimensions

PCA

10th June

timetable

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May

June

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Find nearest neighbors

k-NN

24th June

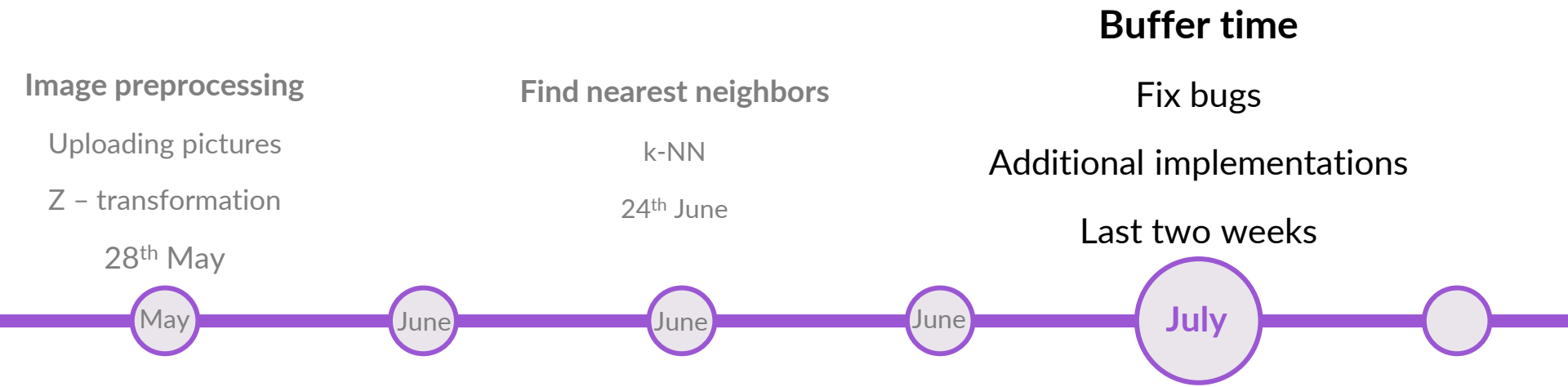
June

June

Evaluation

30th June

timetable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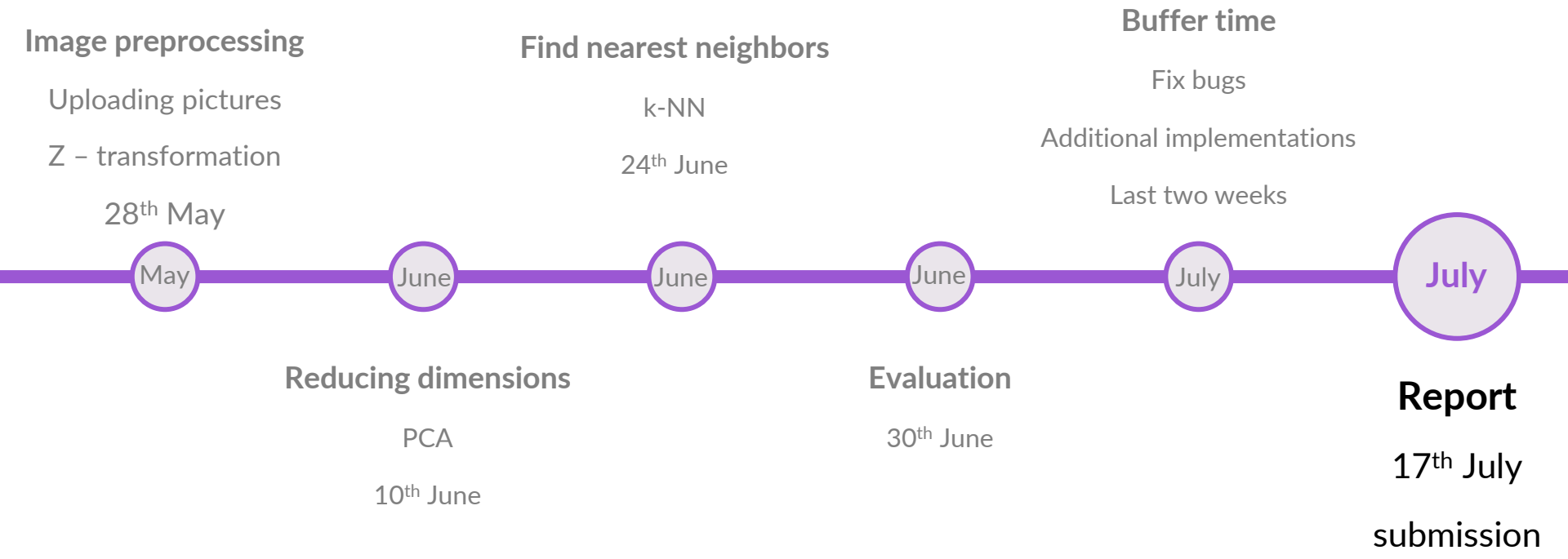
k-NN
24th June
June
Evaluation
30th June
June
Buffer time
Fix bugs
Additional implementations
Last two weeks
July

timetable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July
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17th July
submission

References

[1] https://unsplash.com/de/fotos/a40akJxBhT8 , accessed 14.05.2023

[2] https://medium.com/analytics-vidhya/face-recognition-using-knn-open-cv-9376e7517c9f , accessed 16.05.2023

[3] Pfaffel, A. (2019). Standardisierung (z-Transformation). Statistik Verstehen.

[4] http://ai.stanford.edu/~syyeung/cvweb/tutorial1.html, accessed 14.05.2023 Tutorial 1: Image Filtering.

[5] Lata, Y.V., Tungathurthi, C.K.B., Rao, H.R.M., Govardhan, A., and Reddy, L. (2009). Facial recognition using eigenfaces by PCA. International Journal of Recent Trends in Engineering 1, 587.

[6] https://static.hindawi.com/articles/mse/volume-2019/8234124/figures/8234124.fig.005.jpg, accessed 14.05.2023

[7] https://static.packt-cdn.com/products/9781789347999/graphics/assets/c7c2a1bf-2e9f-4fbc-91ef-6dc853ac9898.png , accessed 14.05.2023

k-NN (k-nearest neighbors algorithm)

OTHER CLASSIFIERS

1. Support Vector Machines (SVMs)
2. Neuronal Networks (CNN)
3. Decision Trees
4. Random Forests
5. Naive Bayes