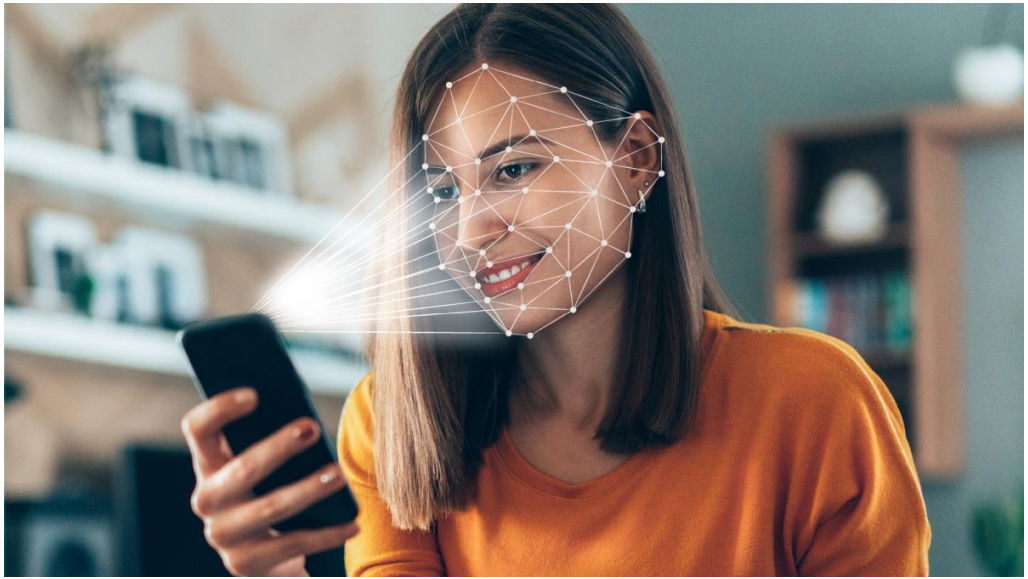
Human face recognition

Group 1: Sarah Manderschied, Lejla Mesic, Emilia Thiel, Sera Kaplan

Tutor: Hannah Winter

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]

Project aim

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

The data set

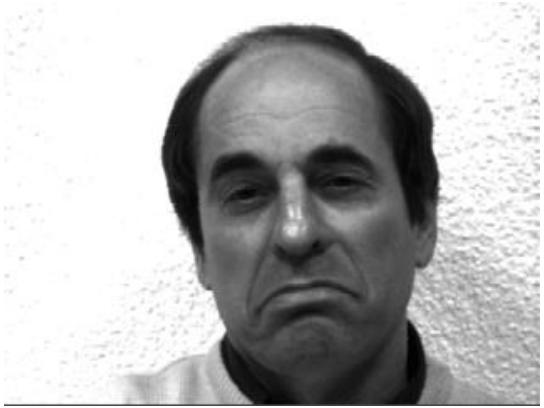
- ➔ Yale Face Database of human faces
- ➔ 165 images from 15 subjects - 11 images per subject
- ➔ GIF files
- ➔ grayscale images normalized by size (320x243 pixels)

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

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

[2]

z-transformation

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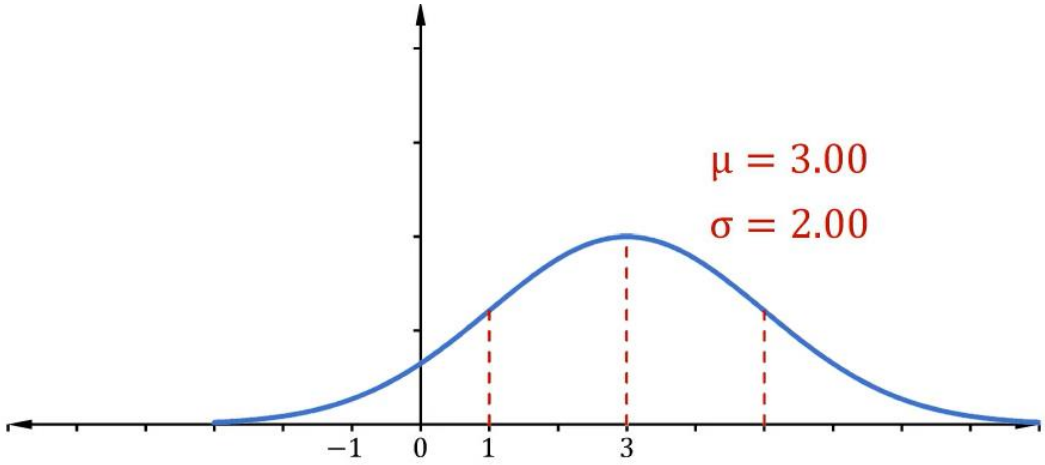

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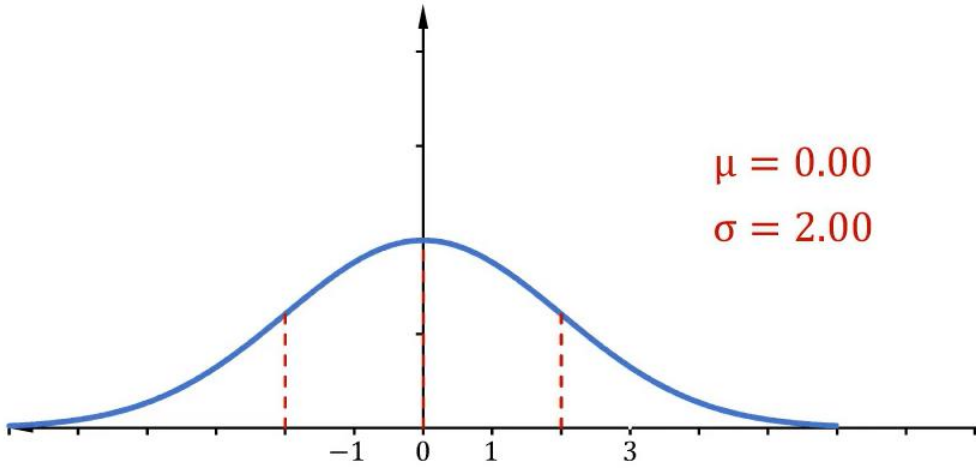

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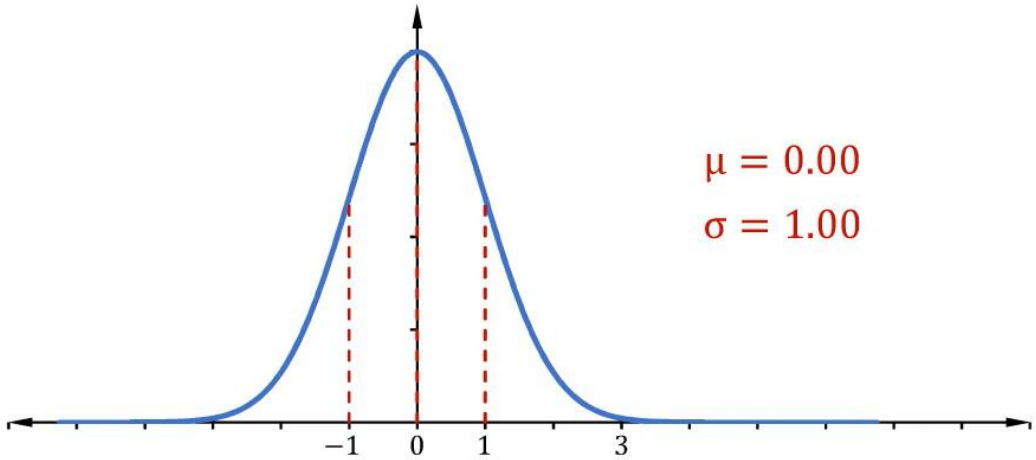

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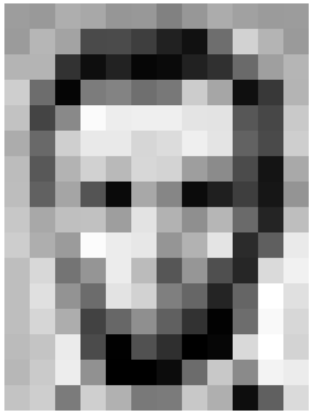
[2]

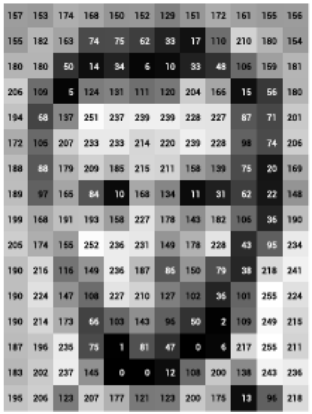
z-transformation

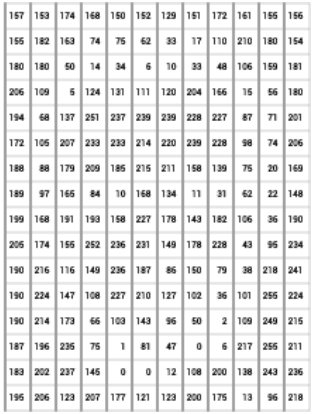
USE FOR US

- investigation of system properties
- basis for PCA

[3]







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

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)

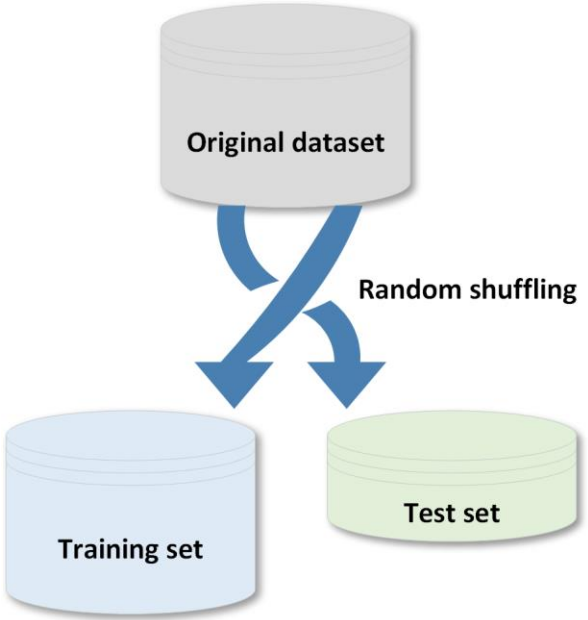
FACIAL LANDMARKS

[5]

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



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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

Image preprocessing

Uploading pictures

Z – transformation

28th May

Find nearest neighbors

k-NN

24th June

May | June | June

Reducing dimensions

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June

Find nearest neighbors

k-NN

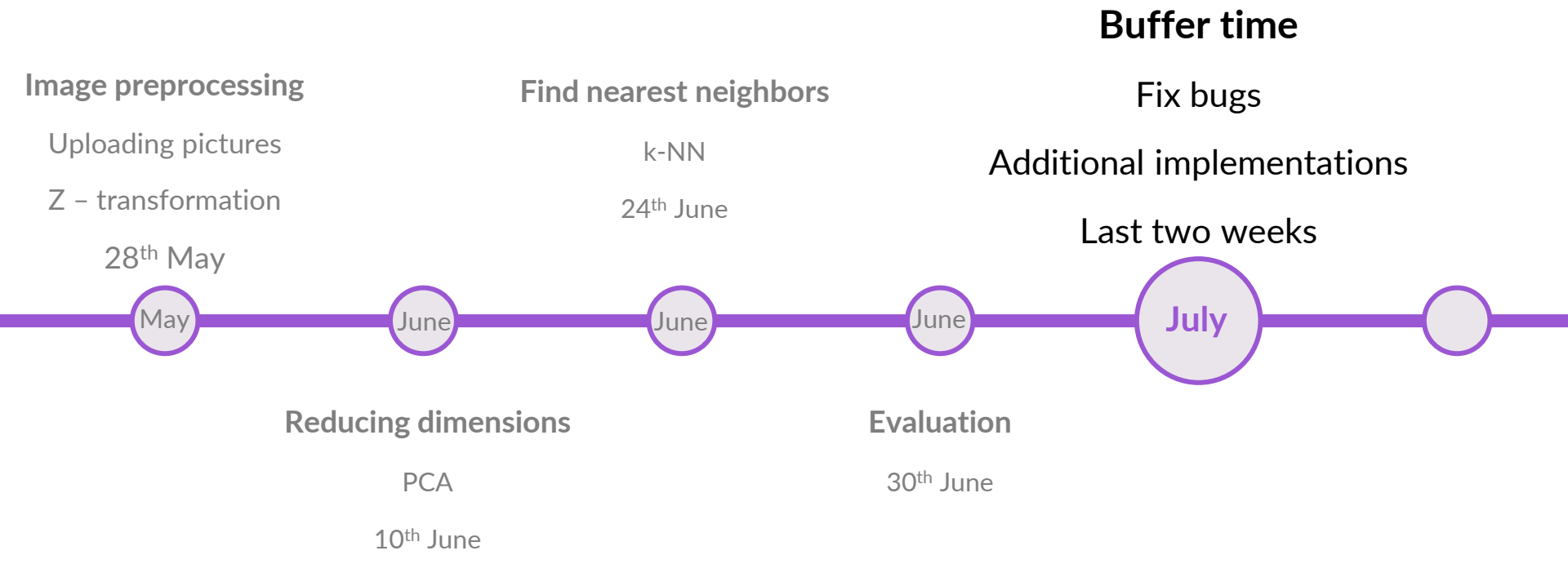
24th June

June

Evaluation

30th June

timetable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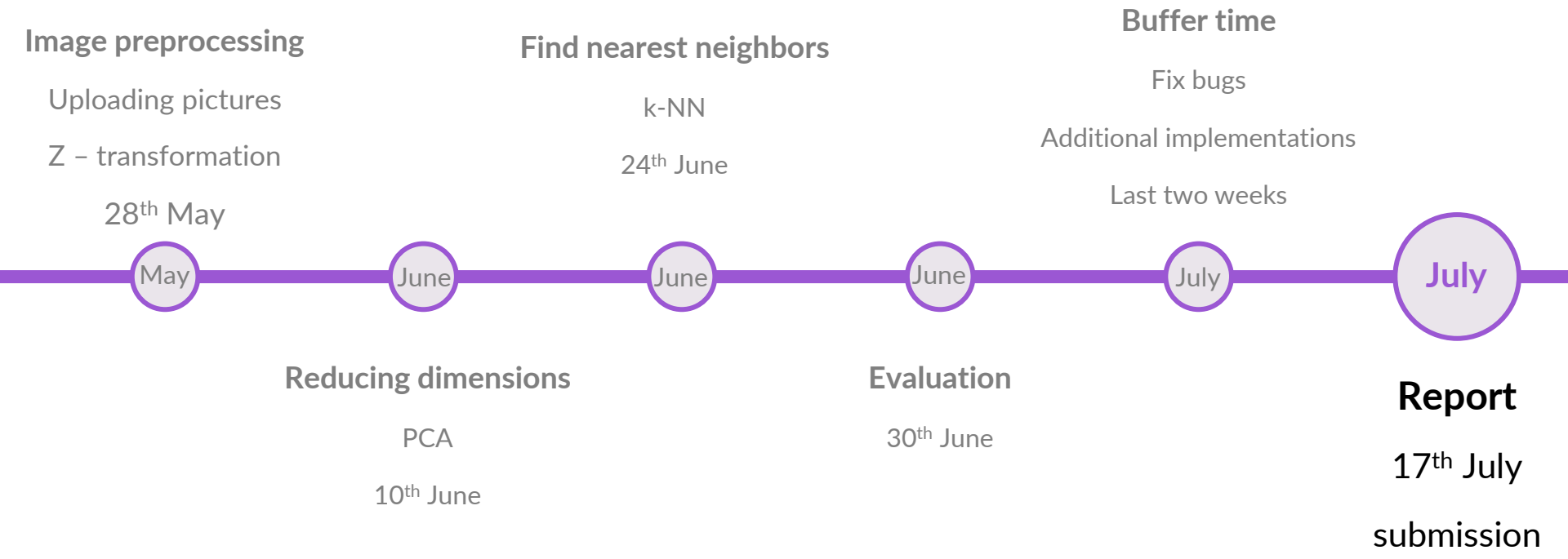
Evaluation
30th June
June
Buffer time
Fix bugs
Additional implementations
Last two weeks
July

timetable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Report
17th July
submission

References

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

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

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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