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Facerecognition for social communities and online image databases

Diplomarbeit - Endvortrag

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Agenda

- 1 Goals
- 2 Facerecognition Pipeline
- 3 Tests
- 4 Facerecognition Pipeline Extension (social context)
- 5 Outlook
- 6 Sources

1. Goals

Goals

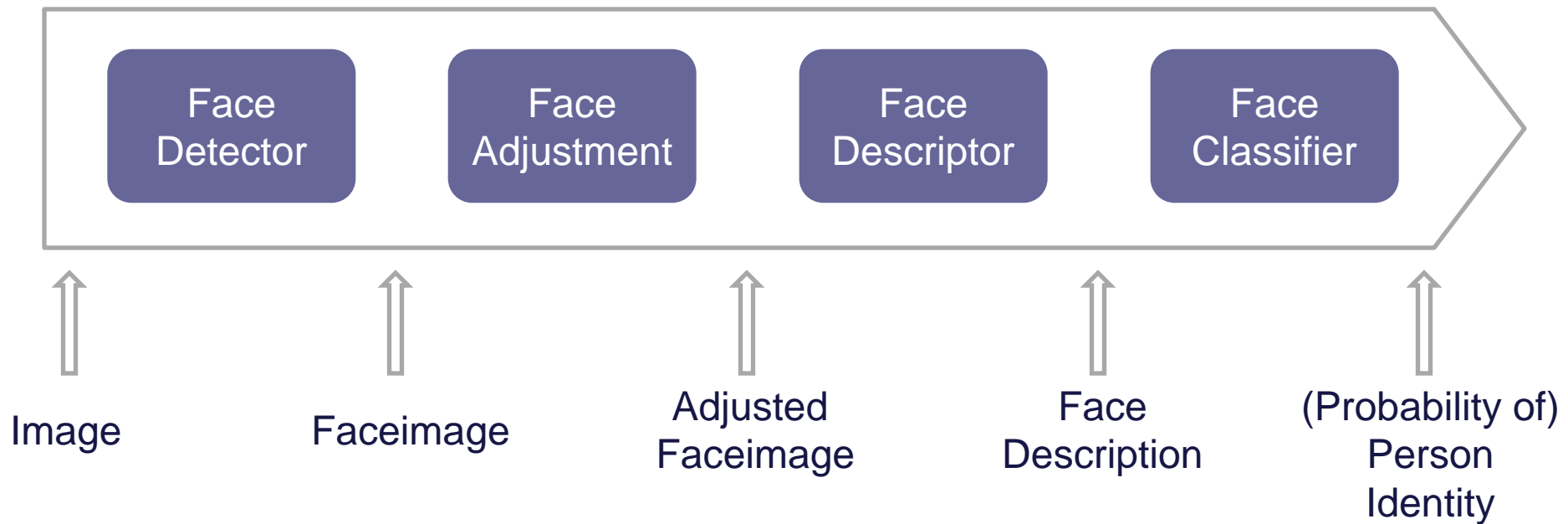
- Implementaion of an face recognition algorithm
 - „Hello my Name is Buffy, automatic naming of characters in tv video.“[8]
- Can multi-model context improve face recognition?

Context

- Large scale image, Data Mining
- Object Recognition
- Kooaba, photocontext.org

2. Facerecognition Pipeline

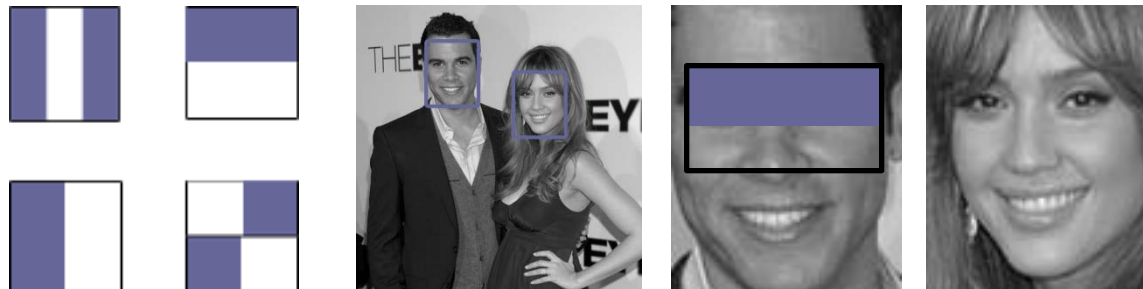
Facerecognition Pipeline





Facedetector

- Viola and Jones [1]
 - Simple features
 - Integral Image
 - Ada-Boosting:
Combination of weak classifier to a strong classifier
 - openCV implementation



fotos: [6]



Face Adjustmend – Pose

- Facial Features Detection
 - Pictorial Structures [2]
 - 9 detected features + 4 calculated features
- Face Normalization
 - Affine Transformation

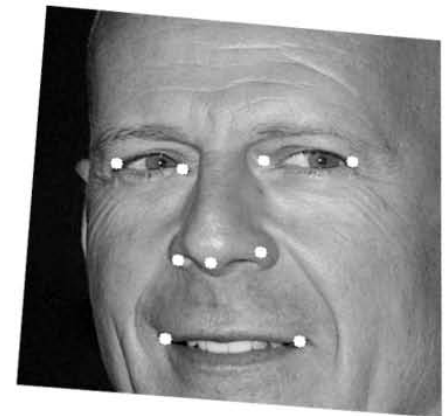
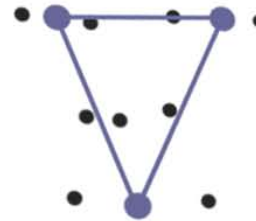
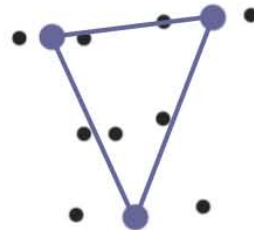
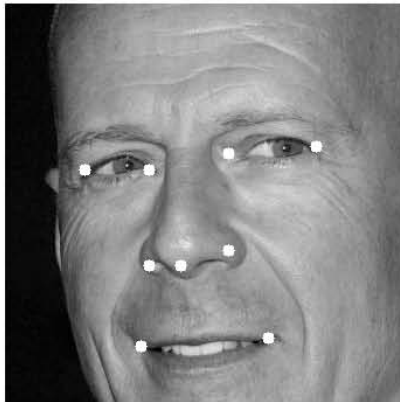


foto: [6]



Face Descriptor

- Point of Interest appearance description
 - Pixel based descriptor
 - Radius 15 pixel
 - Dimension 167

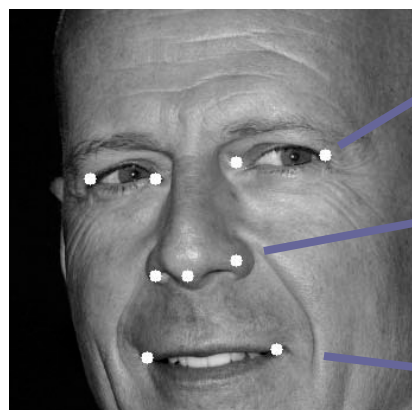
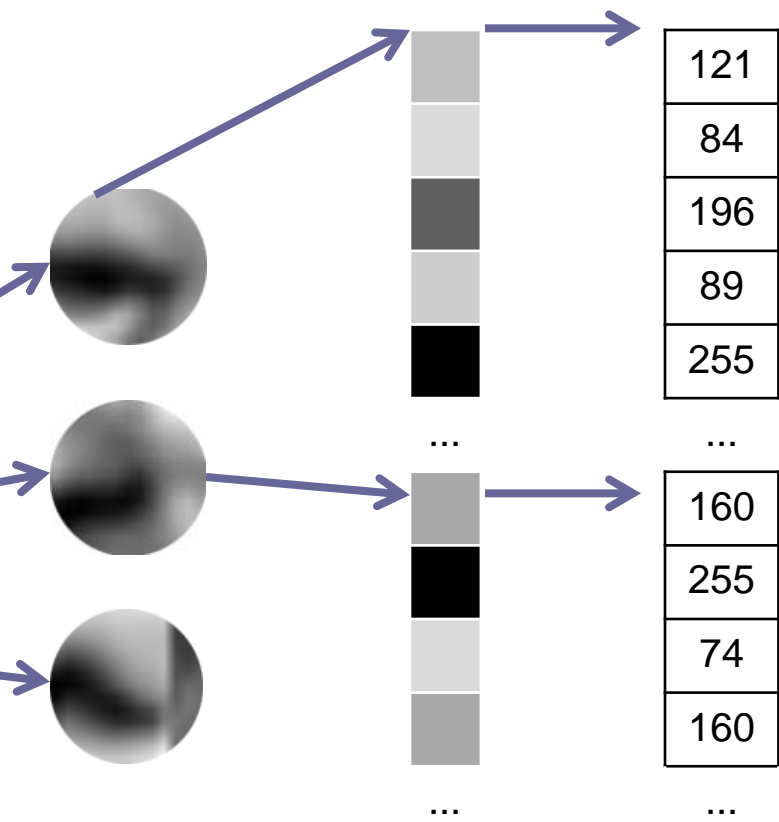


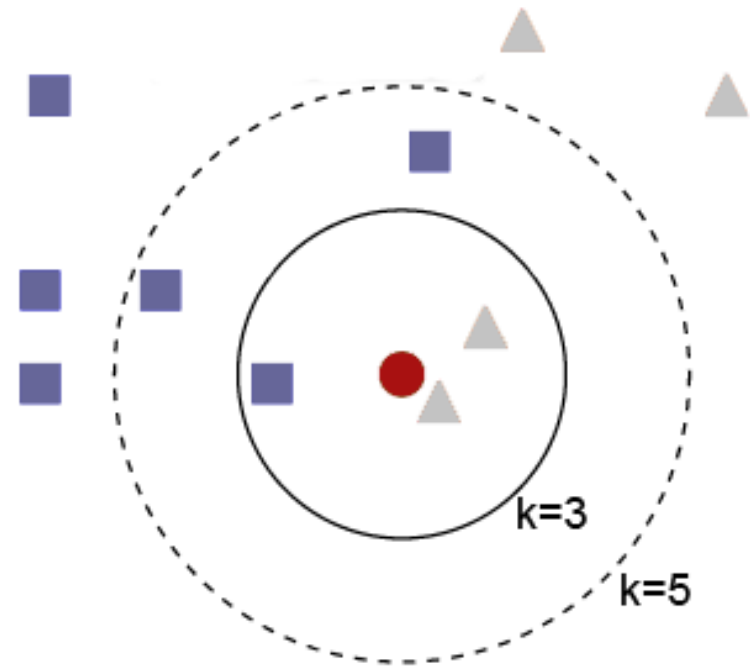
foto: [6]





Classifier

- k-Nearest Neighbor
 - Euclidean Distance
 - majority vote of its neighbors
- Problem:
 - Classification is time consuming

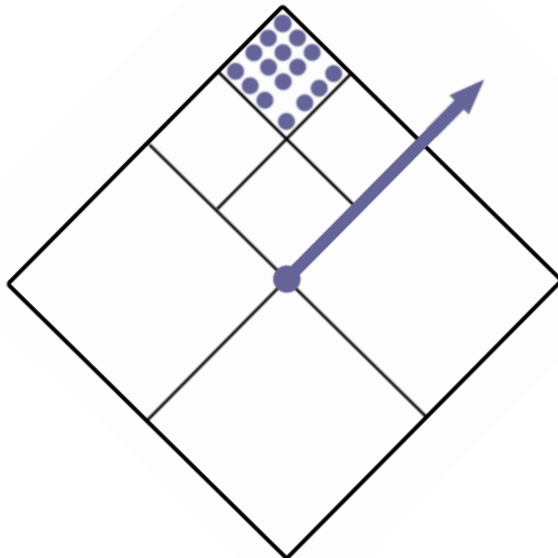


Improvements.

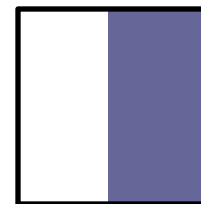


Point of Interest Descriptor

- SURF Descriptor [3,4]
 - Haar Wavelets (Simple Features)
 - 16 subrectangles, 4 values per rectangle
 - 64 dimension
 - Scale- and rotationinvariant



dx



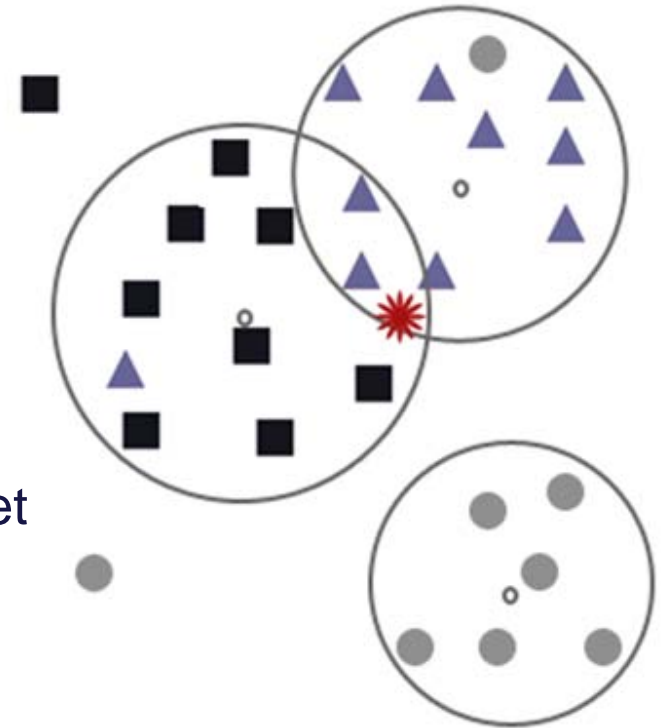
dy

$$\begin{pmatrix} \dots \\ \sum dx \\ \sum |dx| \\ \sum dy \\ \sum |dy| \\ \dots \end{pmatrix}$$



„Booble“ k-Nearest Neighbors

- Improvement of quality and speed
- Reduction of the possible label set
 - maximal distance from the query to the class centroid
- Reduction of errors inside the trainingsset
 - maximal distance inside the class





Number and Position of Point Of Interest

- Approach 1: regions
 - Face divided into 5 regions
 - Individual alignment for each region
 - „Dense sampling“ in each region

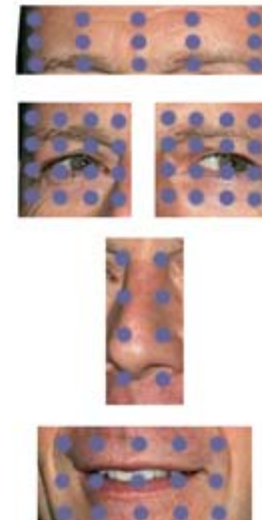


foto: [6]



Number and Position of Point Of Interest

- Approach 2: Mesh
 - 173 facial features points

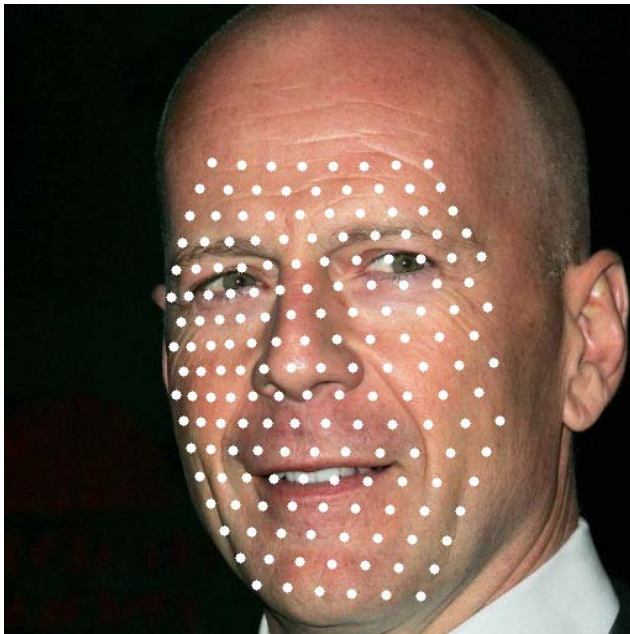


foto: [6]



Number and Position of Point Of Interest

- Approach 2: Mesh
 - 173 facial features points
 - X triangles
 - X affine transformations

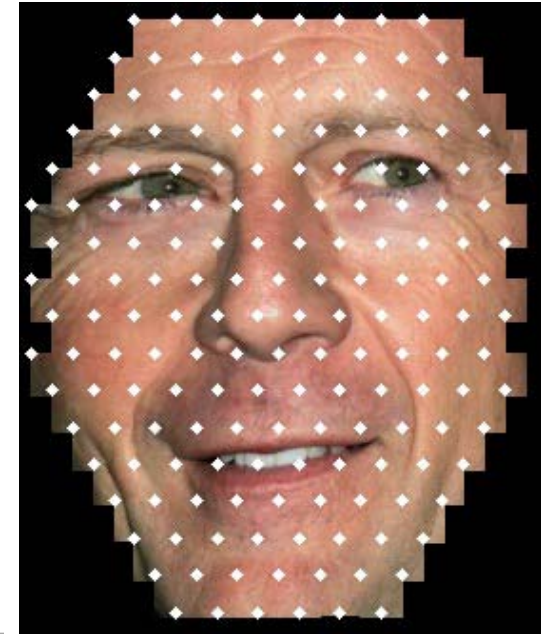


foto: [6]



Number and Position of Point Of Interest

- Approach 2: mesh
 - 173 facial features points
 - 519 triangles
 - 519 affine transformations



fotos: [6]



Number and Position of Point Of Interest

- Approach 2: mesh
 - Unsupervised Face Alignment by Robust Nonrigid Mapping

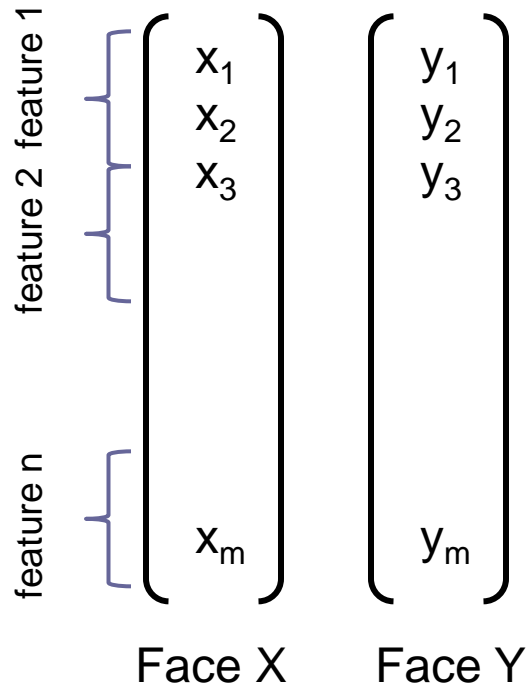


fotos: [6]



Number and Position of Point Of Interest

- Approach 4: weighted mesh
- Problem:
 - Not every feature has the same self-information



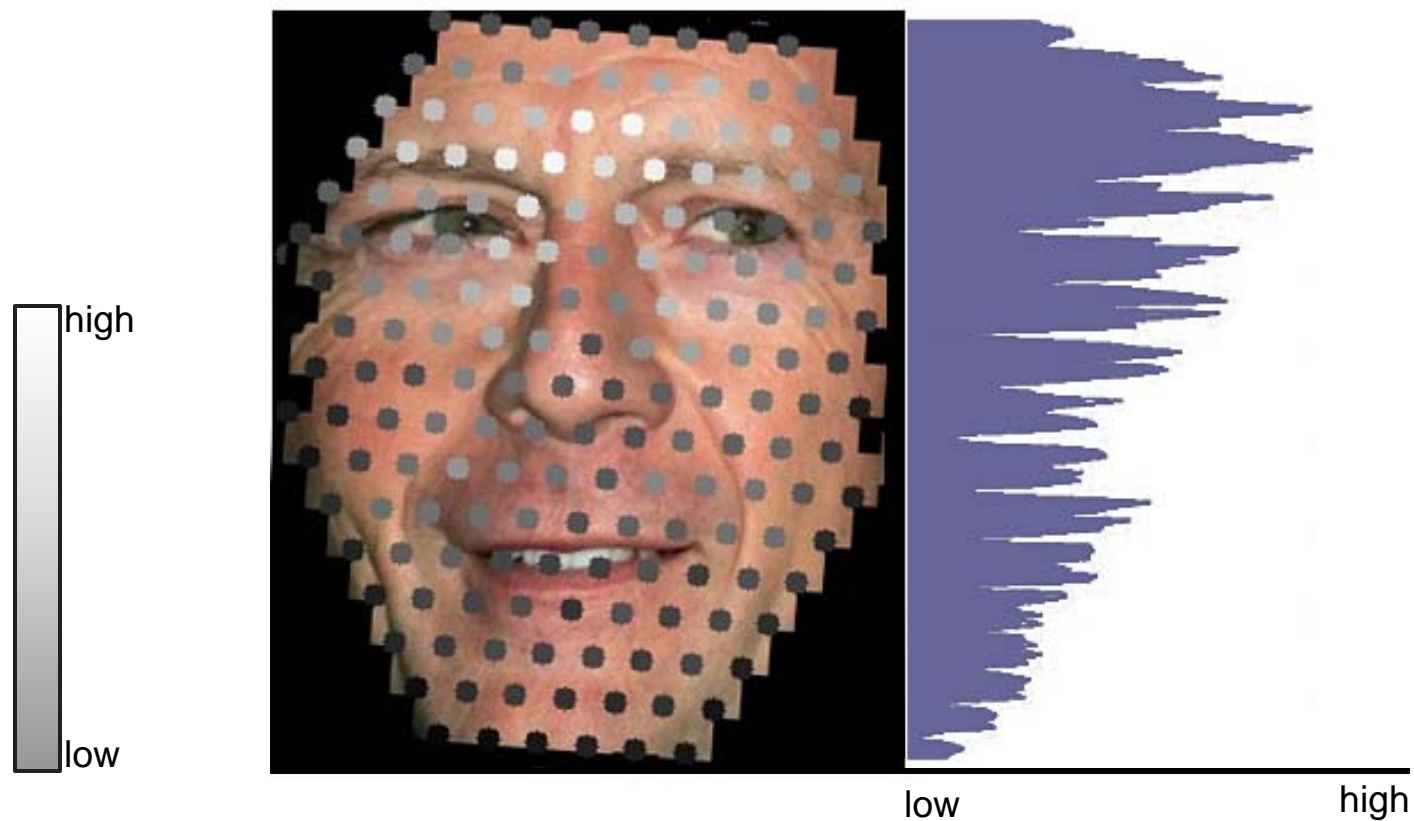
- Euclidean Distance:

$$\sqrt{\sum (x_i - y_i)^2}$$



Number and Position of Point Of Interest

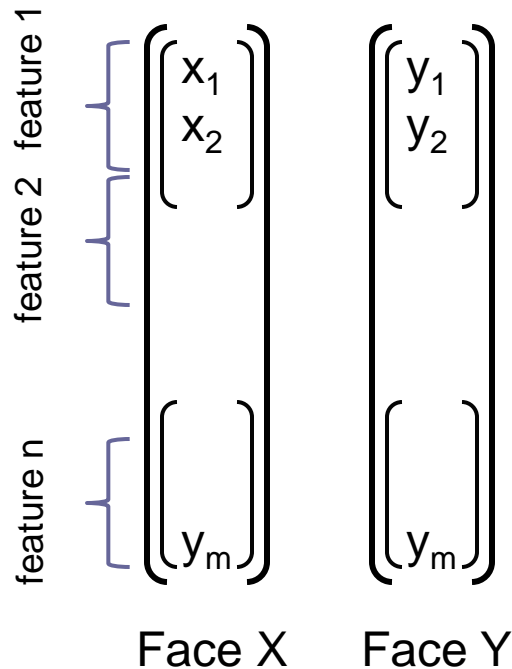
- Self Information of every feature



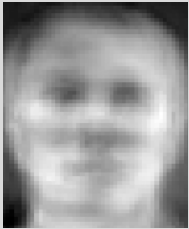


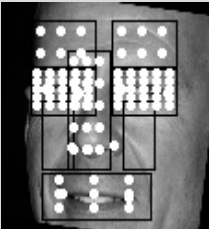




Number and Position of Point Of Interest

- Approach 4: weighted mesh

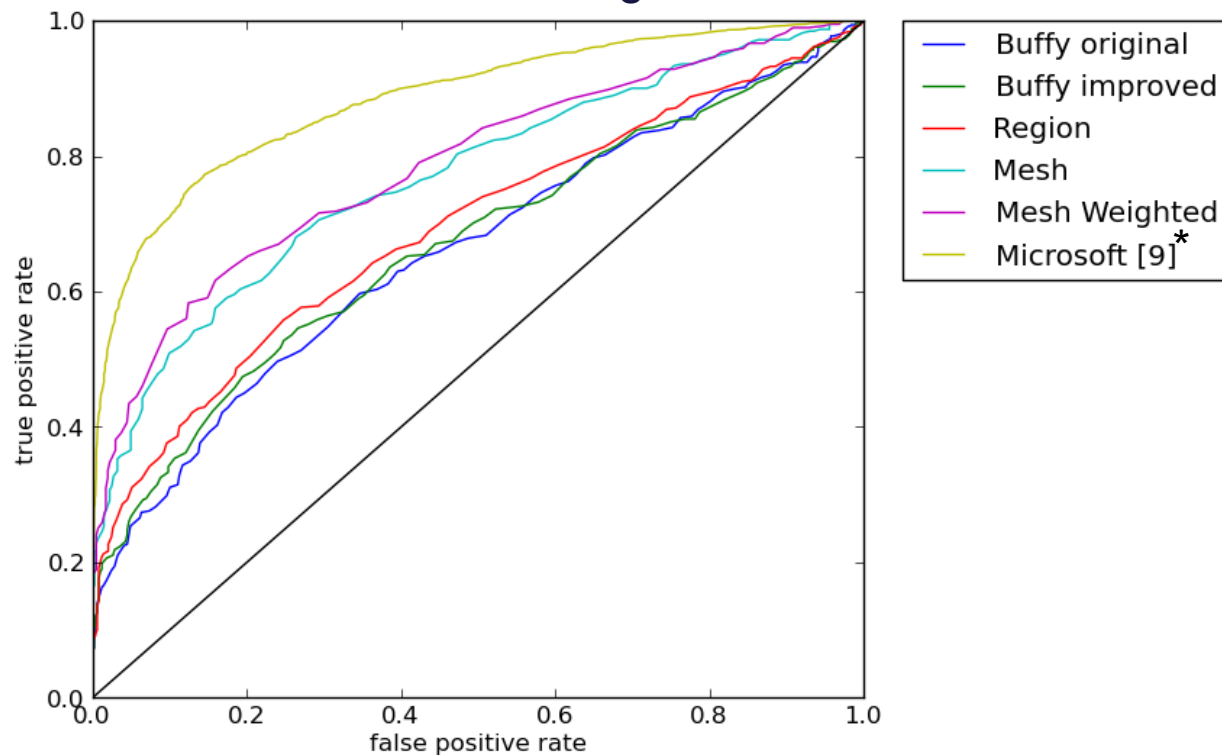


- Distance:
$$\sum d(f_i, f_j) * w_i$$
 - $w_i :=$ positive rate of feature i
 - $d(f_i, f_j) :=$ euclidean distance between the two feature i

	Eigen faces	Original „Buffy“	Improved „Buffy“	Regions	Mesh	Weighted Mesh
Example						
POI's	-	13	13	150	173	173
Descriptor size	-	2171	2496	9600	11072	11072
LFW Small	0.13	0.56	0.66	0.61	0.66	0.81
LFW Big	0.098	0.28	0.33	0.47	0.60	0.76

Receiver operating characteristic (ROC curve)

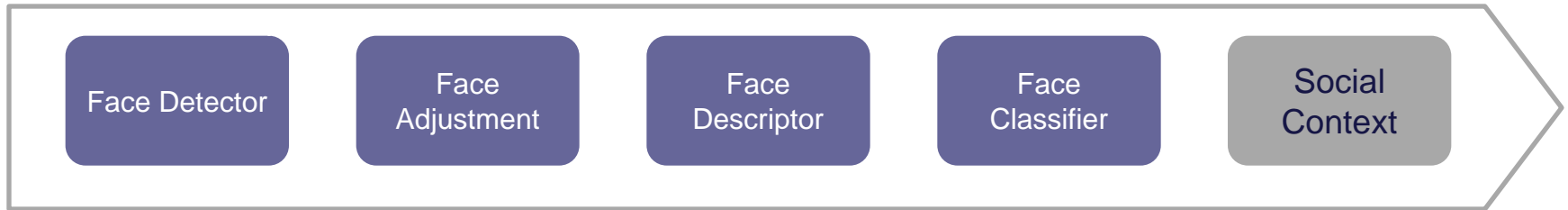
- Labeled Faces in the Wild challenge „View 1“



*View 2

3. Facerecognition Pipeline Extension

Facerecognition Pipeline Extension



- Without social network context:
 - $P(\text{face} = \text{identity} | \text{photo}) = \text{FaceScore}(\text{face})$
 - $\text{FaceScore}(\text{face}) = \text{likelihood distribution over all identities}$
- With social network context:
 - $P(\text{face} = \text{identity} | \text{photo}, \text{sc})$
 - $\text{sc} = \{ \text{Set of friends, identity of fotographer, friends of fotographer, ... } \}$

Social Context

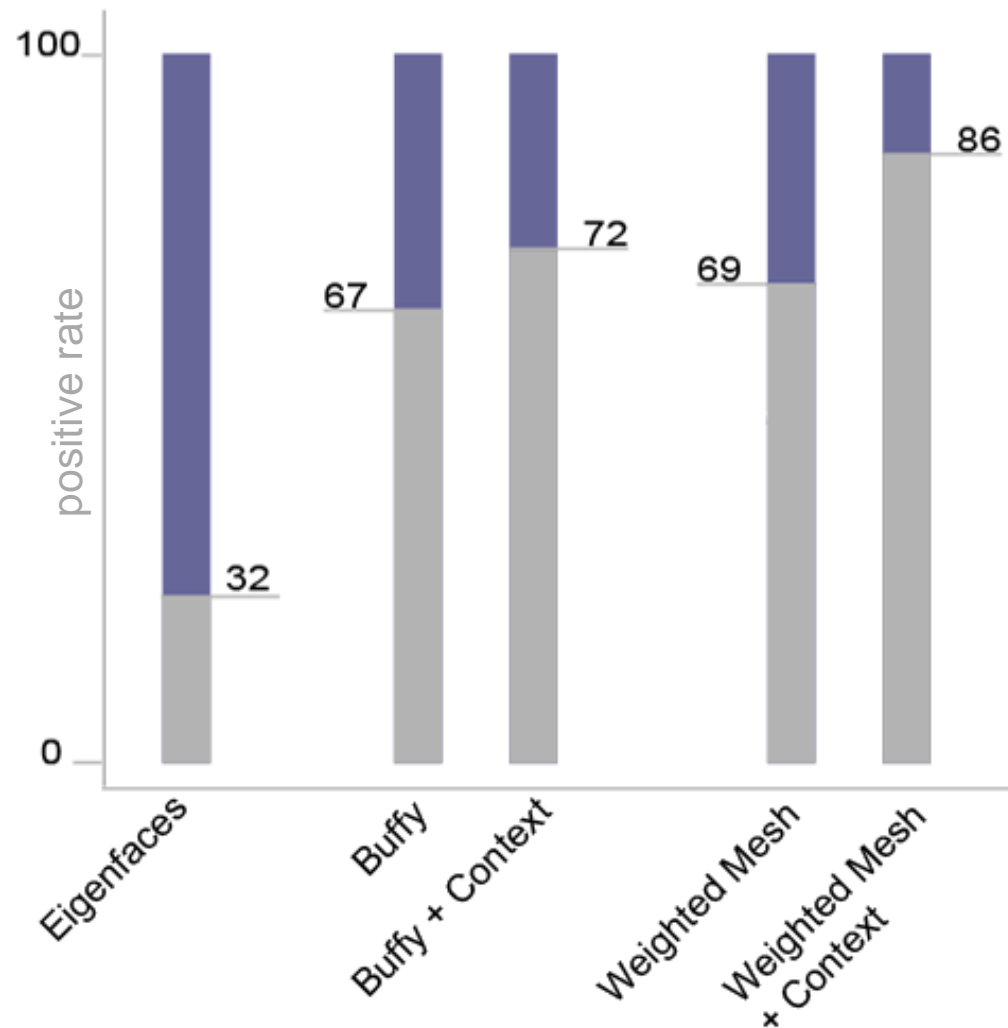
- Popularity
 - Some persons appear more often than others
- Friendship with photographer
 - 81% of the tagged persons appear together with the photographer in another photo.
- Co-occurrence
 - Persons who appear in the same photo together have a higher likelihood of appearing together in another photo.
 - 76% of persons who appear in the same photo are Facebook friends.
- Temporal re-occurrence
 - Often persons appear multiple times in an album (event).

Test

- Trainingsset:
 - All facebook-photos containing friends of the testuser
 - Friends: 563
 - Images: >10.000
 - Faces: 19.620
- Testset:
 - All uploaded photos by the testuser
 - Albums 44
 - Photos 1990
 - Handlabeled Faces: 1508

Test

- Person: 8024037
- Album: 203868



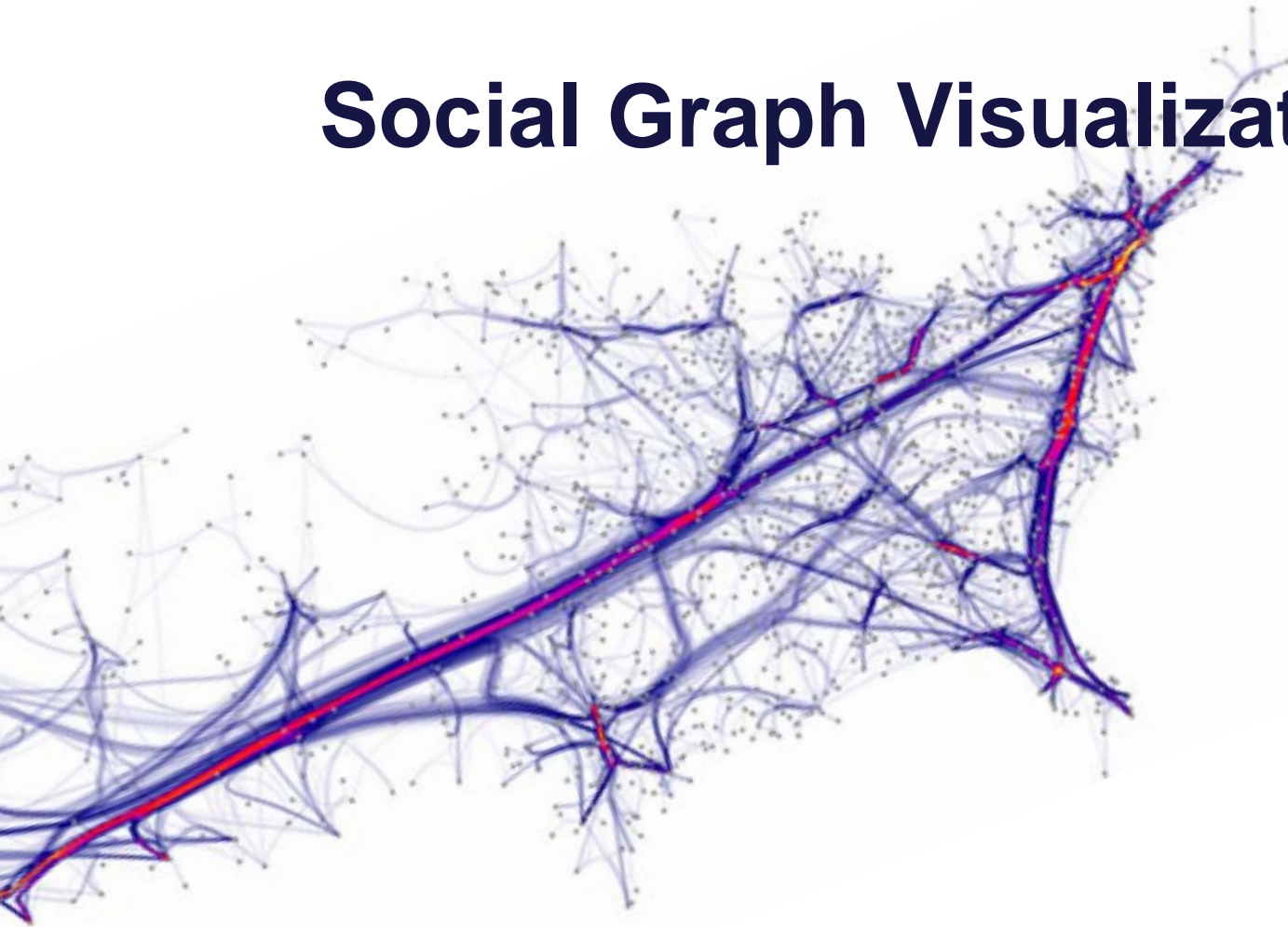
Algorithm	Social Context	Test- Albums			
		203868	190908	177364	16421
Eigenfaces	No	0.32	0.21	0.25	0.19
Improved Buffy	No	0.67	0.66	0.73	0.68
Improved Buffy	Yes	0.72	0.69	0.75	0.76
Weighted Mesh	No	0.69	0.64	0.84	0.79
Weighted Mesh	Yes	0.86	0.76	0.82	0.85

3. Outlook

Outlook

- Webservice
- Multiclass AdaBoosting for highdimension features
- Poseinvariant Facedescriptor

Social Graph Visualization



**Thank you for your attention.
Any questions?**

- 1: Viola, P. and Jones, M. : Proc. IEEE CVPR : Rapid Object Detection using a Boosted Cascade of Simple, (2001).
- 2: Felzenszwalb, P.F. and Huttenlocher, D.P. : International Journal of Computer Vision : Pictorial structures for object recognition (2005)
- 3: Lowe, D.G. : Object recognition from local scale-invariant features (1999).
- 4: Bay, H. and Tuytelaars, T. and Van Gool, L. : Springer: Surf: Speeded up robust features (2006)
- 5: Danny Holten¹ and Jarke J. van Wijk¹.:Force-Directed Edge Bundling for Graph Visualization (2009)
- 6: Huang, G.B. and Ramesh, M. and Berg, T. and Learned-Miller, E. : Labeled Faces in the Wild: A Database for Studying Face Recognition in Unconstrained Environments (2002)
- 7: Jianke Zhu, Luc Van Gool, and Steven C.H. Hoi. :Unsupervised Face Alignment by Robust Nonrigid Mapping (2009)
- 8: Everingham, M. and Sivic, J. and Zisserman, A.: Hello! my name is... buffy-- automatic naming of characters in tv video (2006)
- 9: