

Seminar #2

PATTERN RECOGNITION

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Seminar Description

- *Introduction to pattern recognition systems*
- *Bayesian decision theory*
- *Feature Extraction and Selection Methods*
- **Example: Face Recognition**

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FACE RECOGNITION

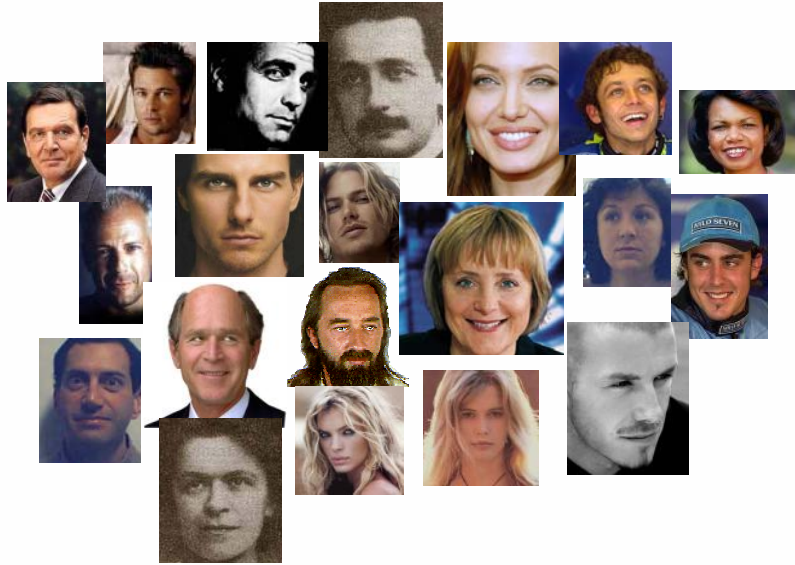
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FACE RECOGNITION

- *The face is our primary focus of attention in social intercourse, playing a major role in conveying identity and emotion.*
- *Humans can recognize thousands of faces....*

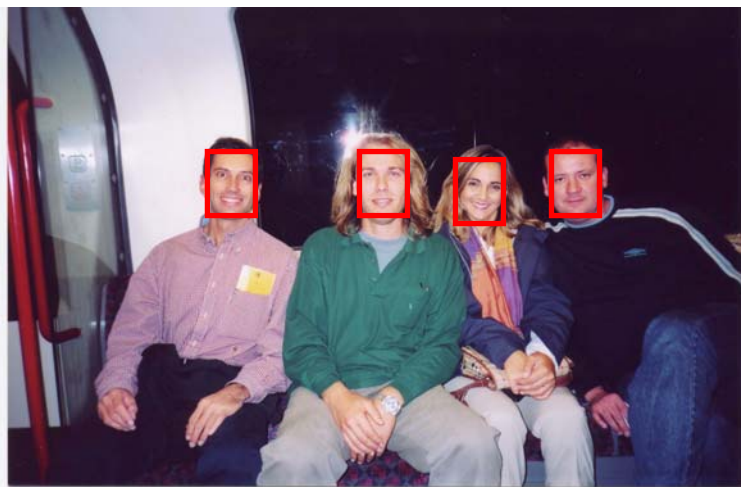
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FACE RECOGNITION



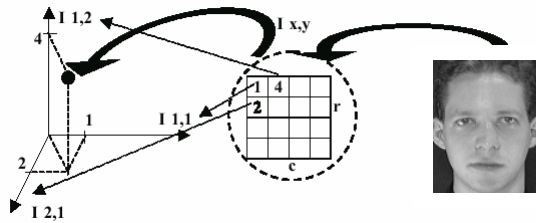
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FACE DETECTION



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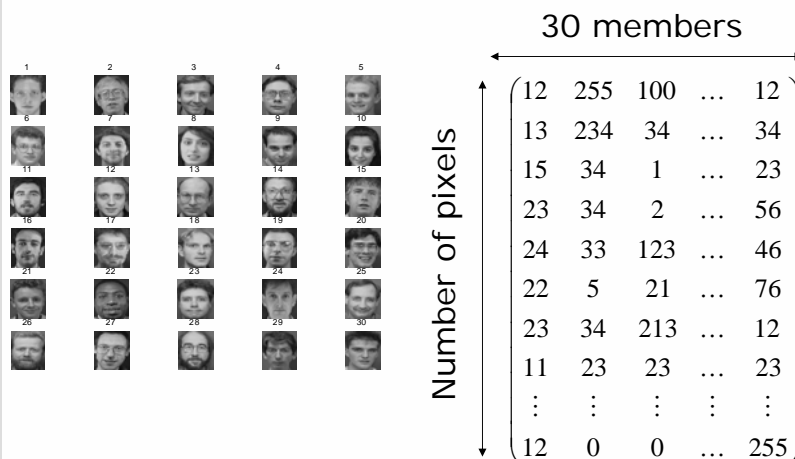
FACE RECOGNITION BY APPEARANCE (I)



Appearance-based methods rely heavily on the concept of an *image space*. A two-dimensional image $I(x,y)$ or any type of visual data (depth maps, flow fields, etc.) may be viewed as a vector (or point) in a very high dimensional space, often called the *image space*, where each coordinate of the space corresponds to one pixel value of the original image. In general, a grayscale image with r rows and c columns describes a vector x in a m -dimensional image space, where $m = r \times c$. With this image representation, the image becomes a very high dimensional *feature vector*, and perhaps the simplest classification approach is a nearest neighbor classifier in the image space

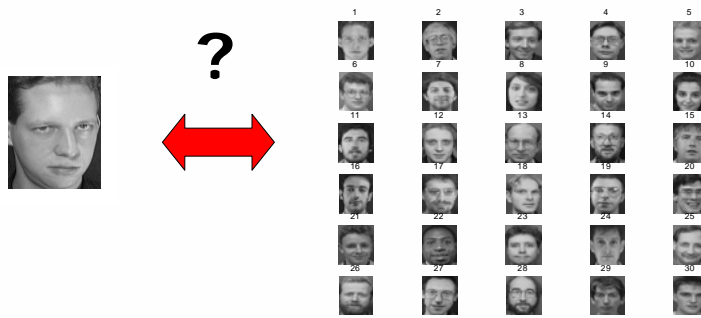
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FACE RECOGNITION BY APPEARANCE (II)



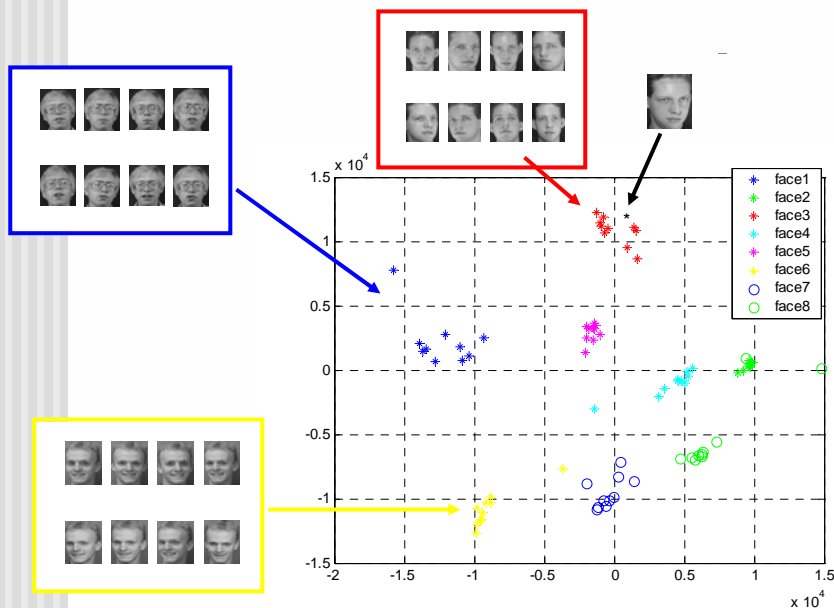
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FACE RECOGNITION BY APPEARANCE (III)

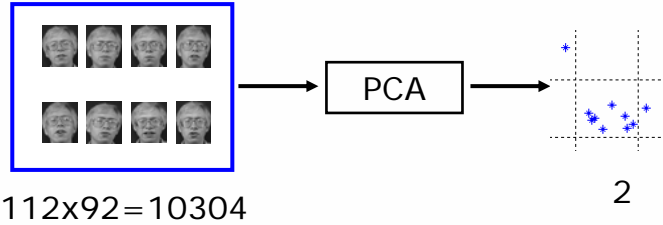


Face recognition systems can not be directly implemented in such large spaces as the classifiers are slowed down by the great size of the input vector.

FACE RECOGNITION BY APPEARANCE (IV)



DIMENSIONALITY REDUCTION



Reducing the dimensionality of the data, we speed up the computations, without losing too much information.

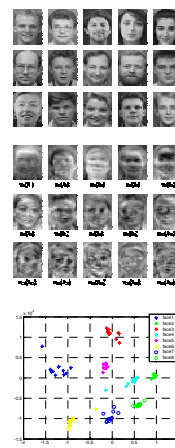
The most popular technique for dimensionality reduction purposes is Principal Component Analysis (PCA).

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FACE RECOGNITION USING PCA

TRAINING

1. Acquire an initial set of face images (the training set)
2. Calculate the PCA transform of the training set (compute the eigenvectors -*eigenfaces*-)
3. Project the training images onto the "eigenspace"

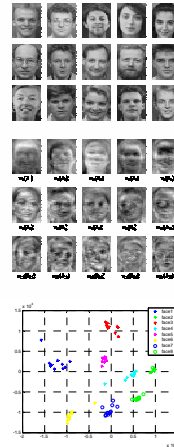


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FACE RECOGNITION USING PCA and Matlab

TRAINING (matlab code)

```
%data matrix
%each column is a face
X=[x1 x2 x3 x4 x5 x6 x7 x8];
% PCA
[V,D,Average] = pc_evectors(X,Nv);
%projecting the data
P=V'*Xm;
```



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FACE RECOGNITION USING PCA and Matlab (II)

TEST (TO RECOGNIZE NEW FACES)

1. Project the new image onto the "eigenspace"
2. Use a classifier to see which class is nearest to the new face

↓
classifier.m

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PRACTICE EXERCISES

PRACTICE 1:

Study of PCA with bidimensional points and with images

Face recognition system based on PCA with the face database ORL.

PRACTICE 2:

Generation of a face database with Stralsund students faces

PRACTICE 3:

Use our face database to test the face recognition system based on PCA.

THIS AFTERNOON!!!