Face Recognition

Course: Biometric Systems
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- Preprocessing
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- Feature Extraction
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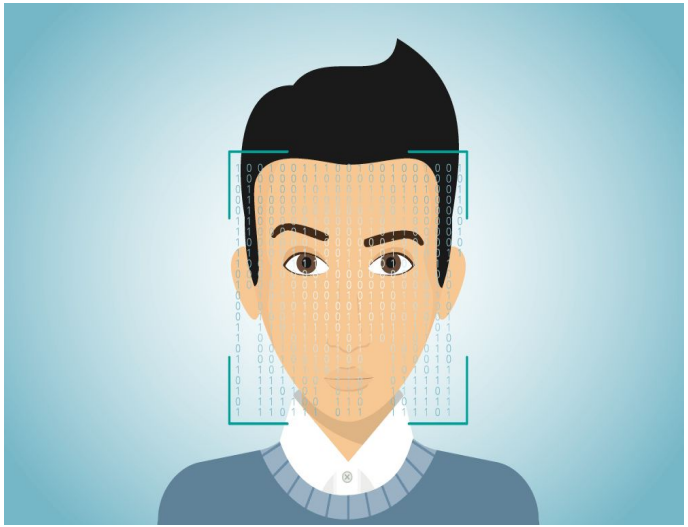
Face Recognition

A **facial recognition system** is a technology capable of identifying or verifying a person from a digital image or a video frame from a video source.



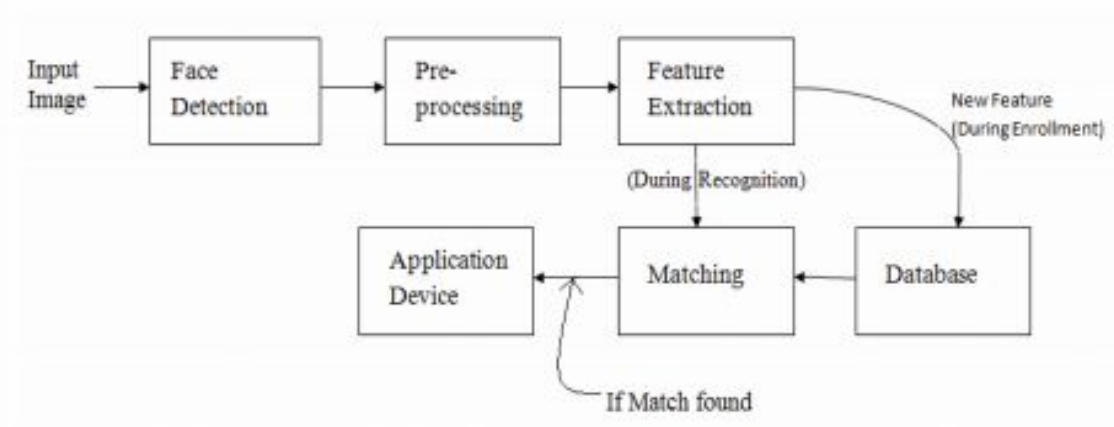
Dataset

- Labeled faces in the wild
- Public benchmark for face verification, also known as pair matching

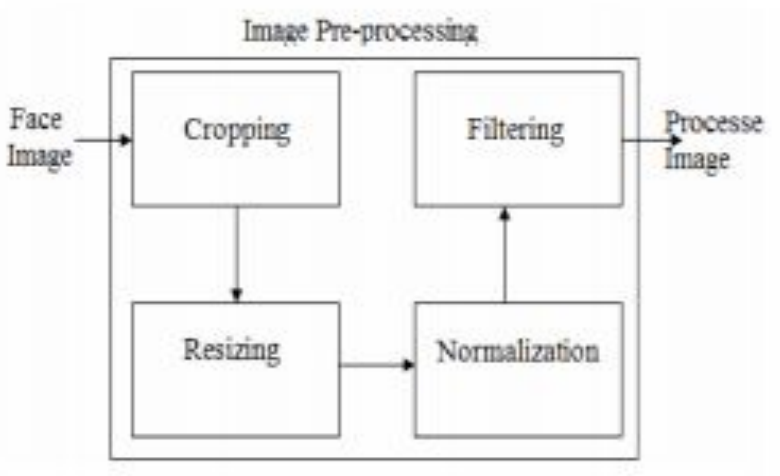
Preprocessing: Why?

Face Recognition is a process that may happen everywhere, even in environments where the people may think that they are not being recognized. To make it possible, images of persons are needed and these images can be taken anywhere and anytime. Saying so the images vary a lot in illumination, noise, pose, etc. Recognition is very strongly depended on the quality of the images and here is why preprocessing is needed, mostly (in our case) to address the illumination and noise problem also to extract faces from images.

Preprocessing



Preprocessing: Steps

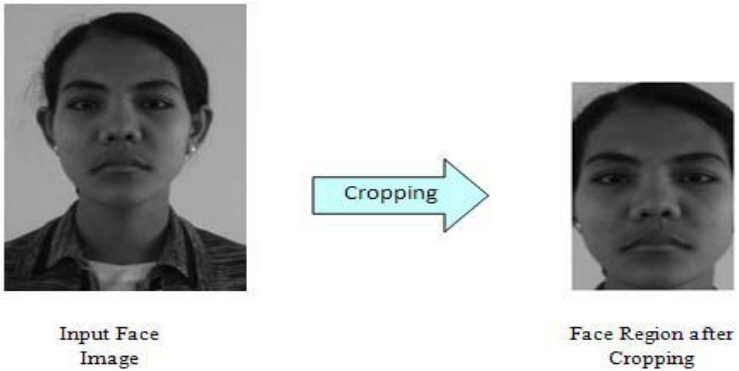


Preprocessing: Cropping & Resizing

Detect the face from the image and crop it

OpenCV: CascadeClassifier(Viola and Jones - crop - resize

DLib: Deep Learning based algorithm, uses face landmarks - crop the face - resize



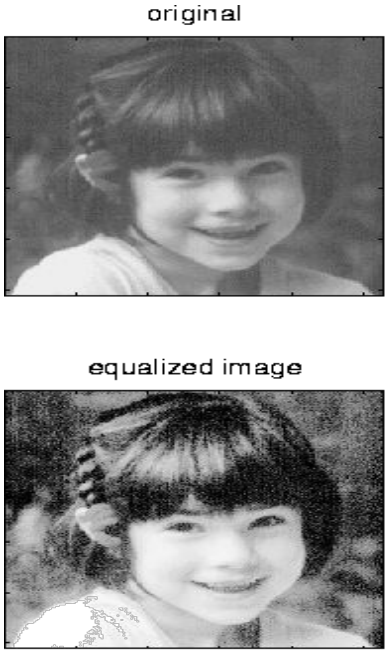
Preprocessing: Normalization & Filtering

Normalization: Histogram Equalization(OpenCV)

-changes the range of pixel intensity values

Filtering: De-noising

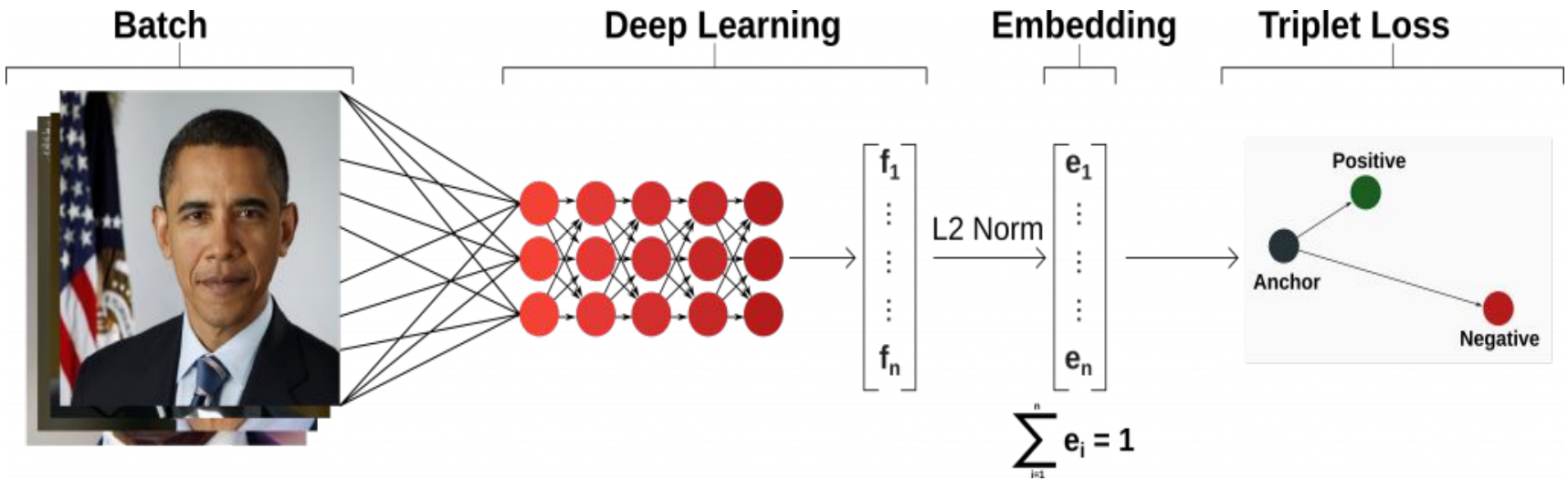
-Gaussian Filter (OpenCV)



Model: FaceNet

- FaceNet: AI based Model
- Neural Network architecture: Inception_Resnet_v2
- Type: Feature Extractor
- Metric: Distance Metric (Triplet Loss)

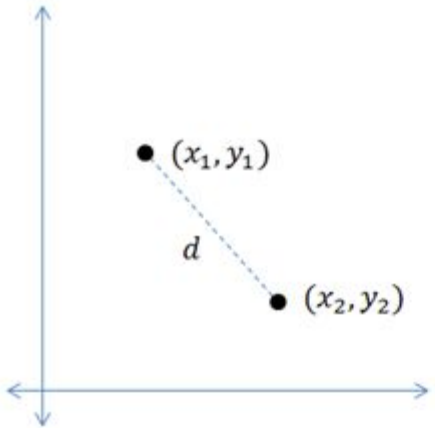
Model: FaceNet



Evaluation:Metric

-Euclidean Distance: Find the distance between two vectors in Euclidean space

-What distance is good? (threshold)

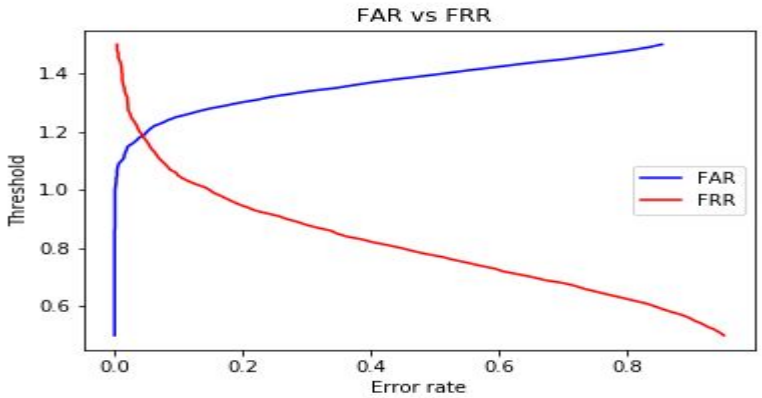


$$d = \sqrt{(x_1 - x_2)^2 + (y_1 - y_2)^2}$$

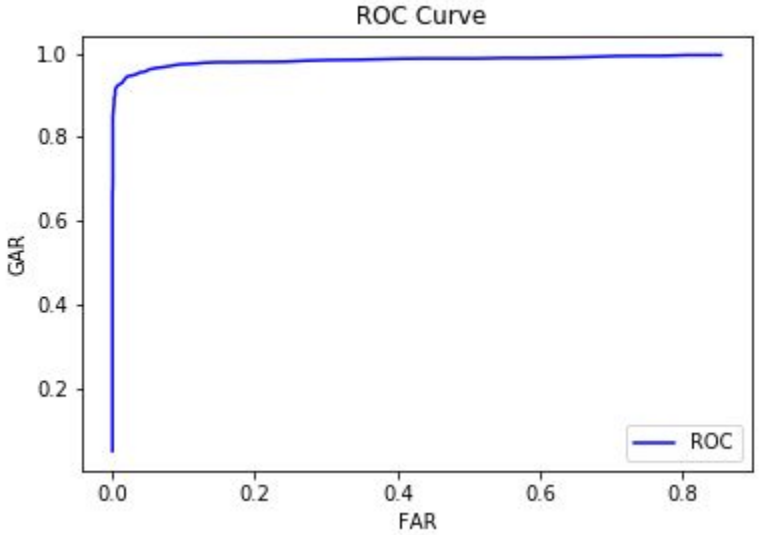
Evaluation: Verification

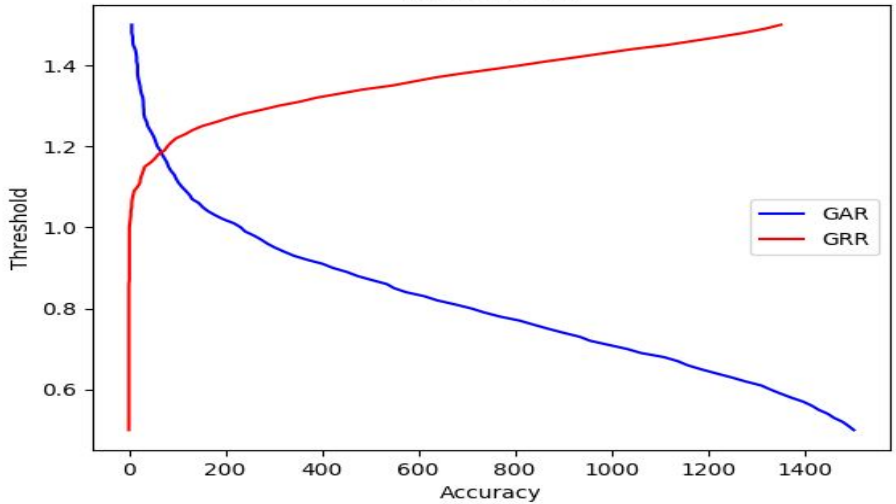
Comparing pairs of image to identify if the claimed identity is true

Finding the threshold for verification: FRR = FAR



Evaluation: Verification





Evaluation: Verification statistics

FRR=FAR is for a threshold equal to 1.19

FAR is ZERO for a threshold = 0.86 and with this threshold the FRR is 33.8%.

FRR is ZERO for a threshold = 1.66 and with this threshold the FAR is 99.6%.

When the threshold is 1.19 we have error rate for the genuine pairs 0.052 (5.2%) which means accuracy of 94.8%, for fake pairs error rate of 0.0505 (5.05%) and accuracy of 94.95%.

Evaluation: Verification

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*********Genuine pairs statistics**********

Numer of errors: 27

Error rate: 0.05454545454545454

Accuracy: 0.9454545454545454

*********Fake pairs statistics**********

Numer of errors: 25

Error rate: 0.050505050505050504

Accuracy: 0.9494949494949495
```

Evaluation: Identification

-Each coming image is compared to all the images in the Gallery (Building the Gallery is a crucial process)

Gallery:

- 351 unique identities

Probes:

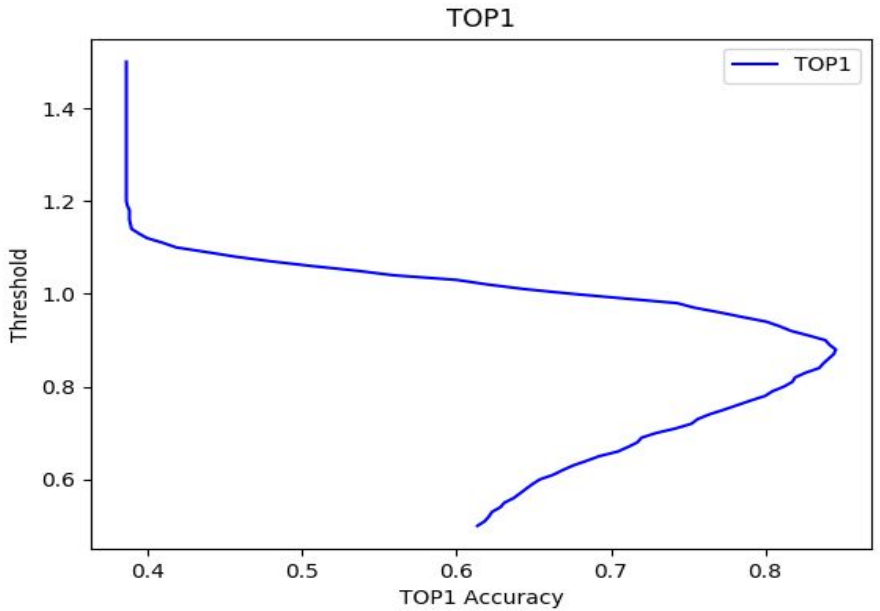
- -807 out of gallery probes
- -688 in gallery probes

Evaluation: Identification

-Top1 accuracy for finding the threshold

-Founded threshold is the one that gives higher Top1 Accuracy

-Threshold: 0.925



Evaluation: Identification

```
SAMPLES:  1485
CORRECT IDENTIFICATION TOP 1:  515
CORRECT IDENTIFICATION TOP 2:  522
CORRECT IDENTIFICATION TOP 3:  522
CORRECT IDENTIFICATION TOP 4:  522
CORRECT IDENTIFICATION TOP 5:  522
CORRECT REJECTION:  687
WRONG OUT OF GALLERY IDENTIFICATION:  120
WORNG REJECTIONS 49
TOP 1 ACCURACY: 0.8094276094276094
TOP 2 ACCURACY: 0.8141414141414142
TOP 3 ACCURACY: 0.8141414141414142
TOP 4 ACCURACY: 0.8141414141414142
TOP 5 ACCURACY: 0.8141414141414142
```