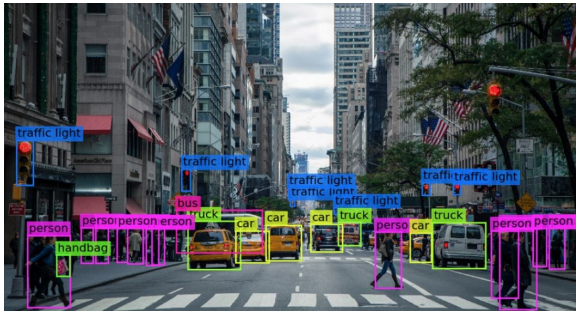
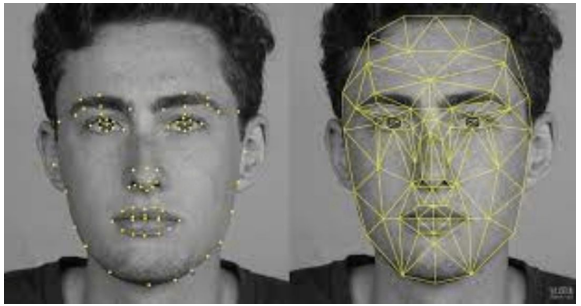
Course-Net
Empowering IT People

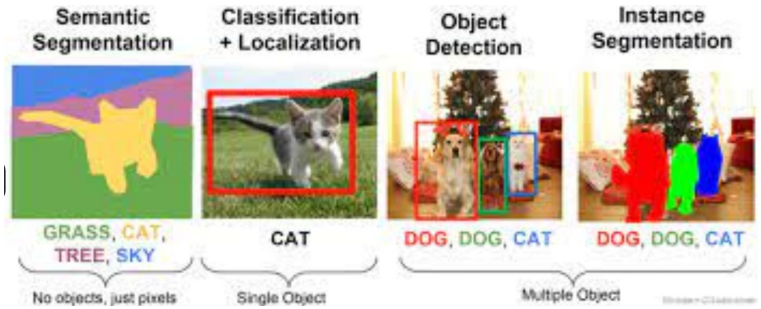
Computer Vision

1. What is Computer Vision
2. Computer Vision Models
3. Face Recognition Introduction
4. How it works
5. Design Application
6. Demos

What is Computer Vision ?







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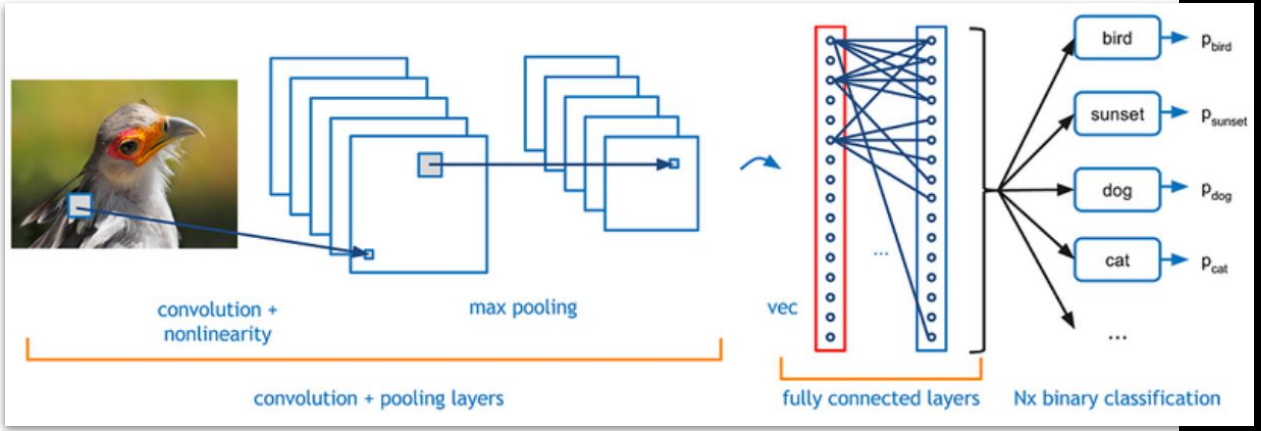
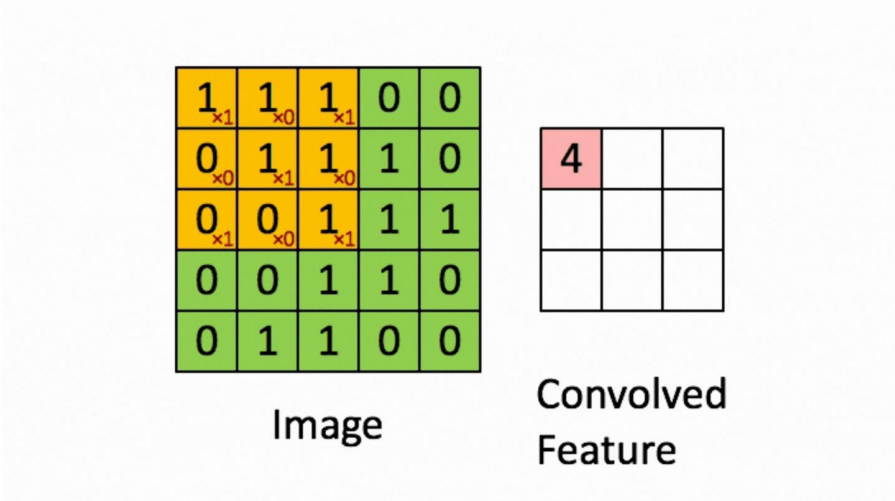
Computer Vision Models

Convolutional Neural Networks (CNNs)



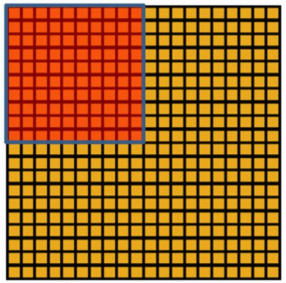
1. Convolutional layer
2. Rectified linear unit (ReLU) Layer
3. Pooling Layer
4. Fully connected layer (FC)

Convolutional Layer

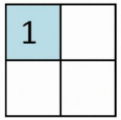


The objective of the Convolution Operation is to **extract** the **high-level features** such as edges, from the input image.

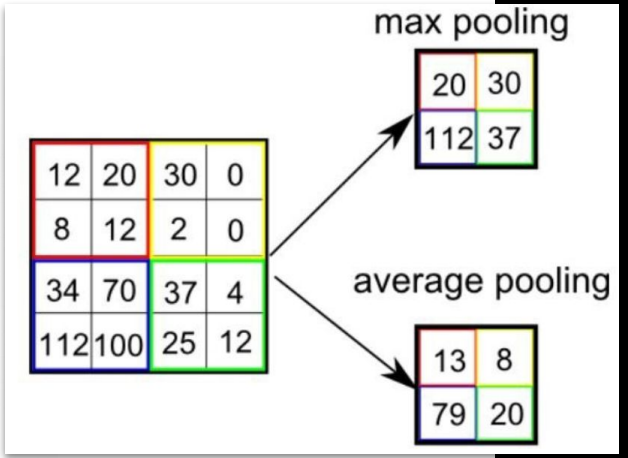
Pooling Layer



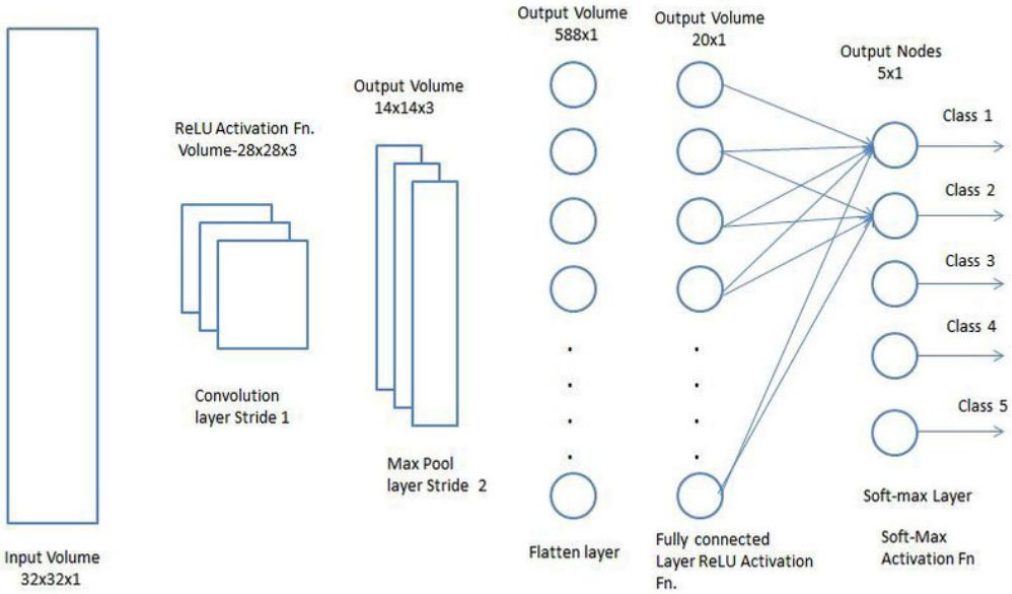
Convolved feature



Pooled feature



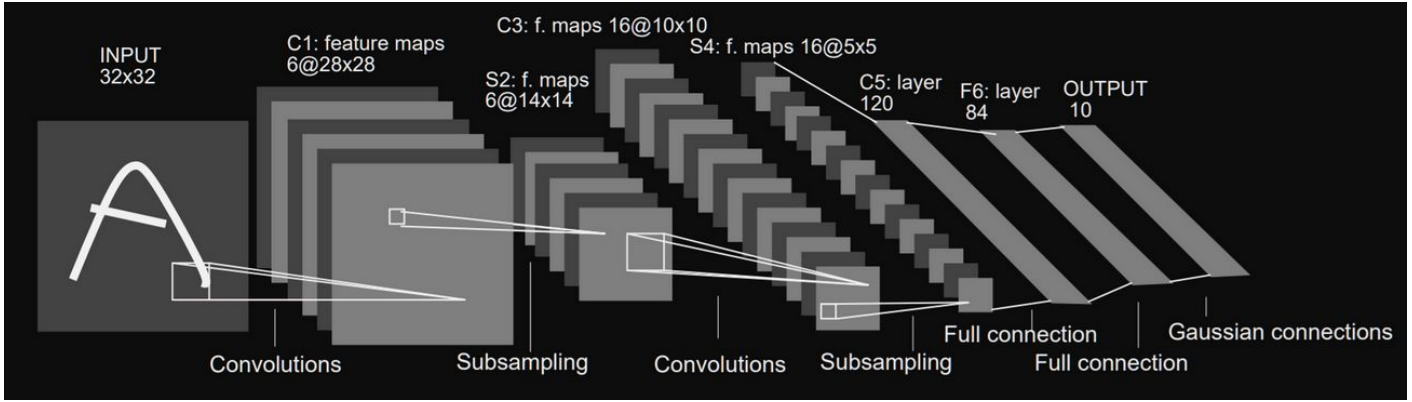
Fully Connected Layer



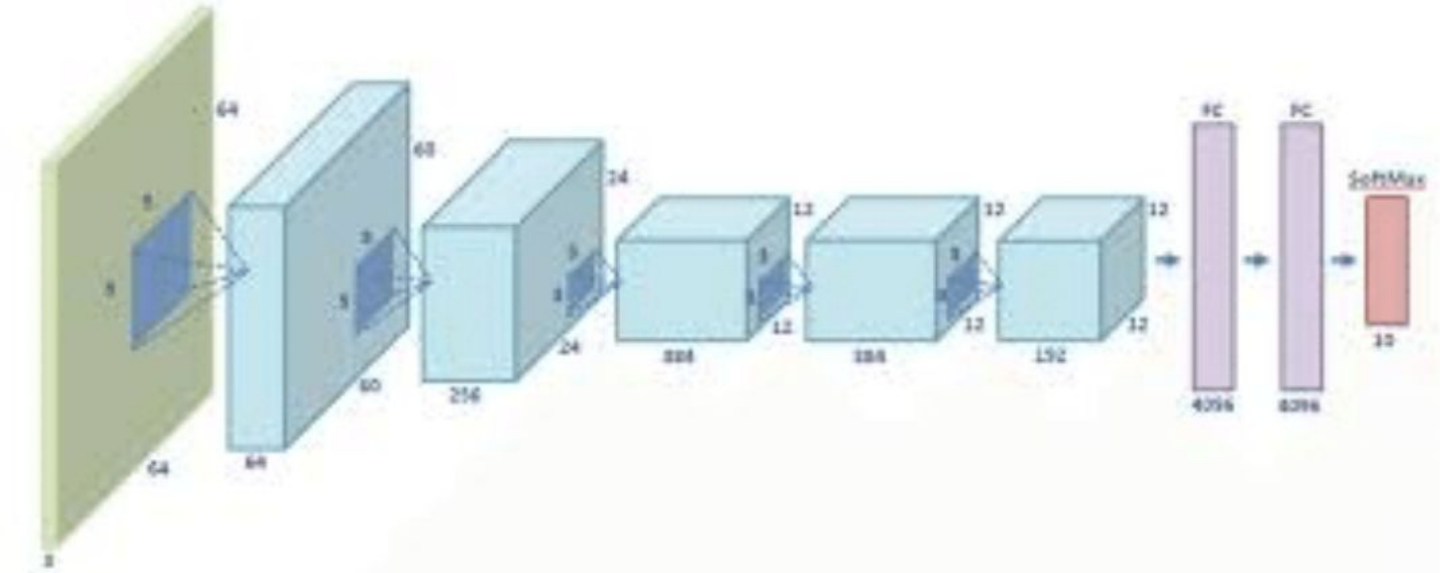
Popular CNN Architectures

1. LeNet
2. AlexNet
3. VGGNet (VGG16 & VGG19)
4. ResNet

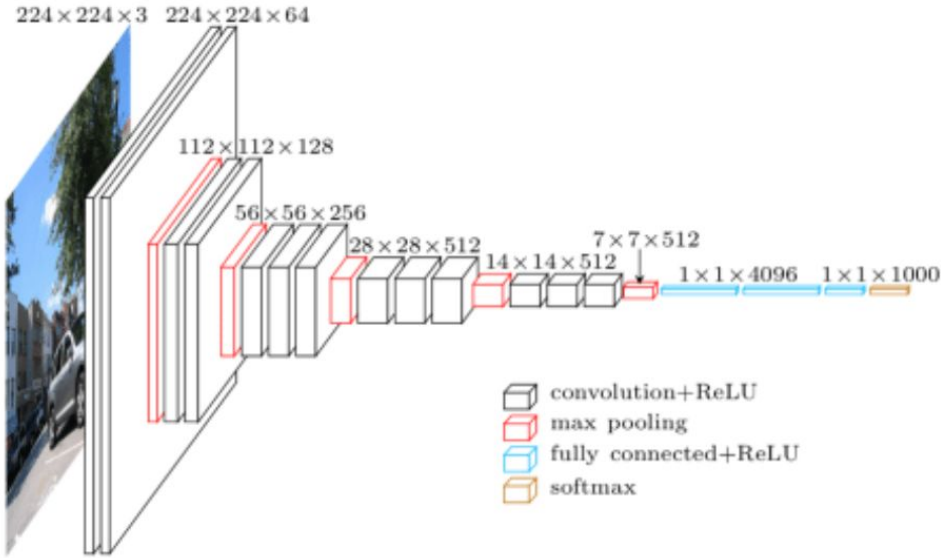
LeNet (1998)


INPUT
32x32
C1: feature maps
6@28x28
S2: f. maps
6@14x14
C3: f. maps 16@10x10
S4: f. maps 16@5x5
C5: layer
120
F6: layer
84
OUTPUT
10
Convolutions
Subsampling
Convolutions
Subsampling
Full connection
Full connection
Gaussian connections

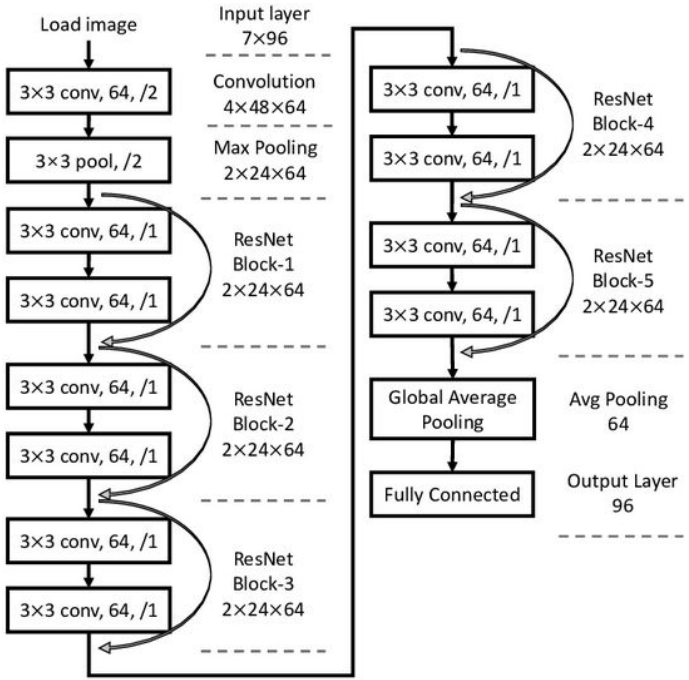
AlexNet (2012)



VGGNet (2014)


224×224×3
224×224×64
112×112×128
56×56×256
28×28×512
14×14×512
7×7×512
1×1×4096
1×1×1000
convolution+ReLU
max pooling
fully connected+ReLU
softmax

ResNet (2015)

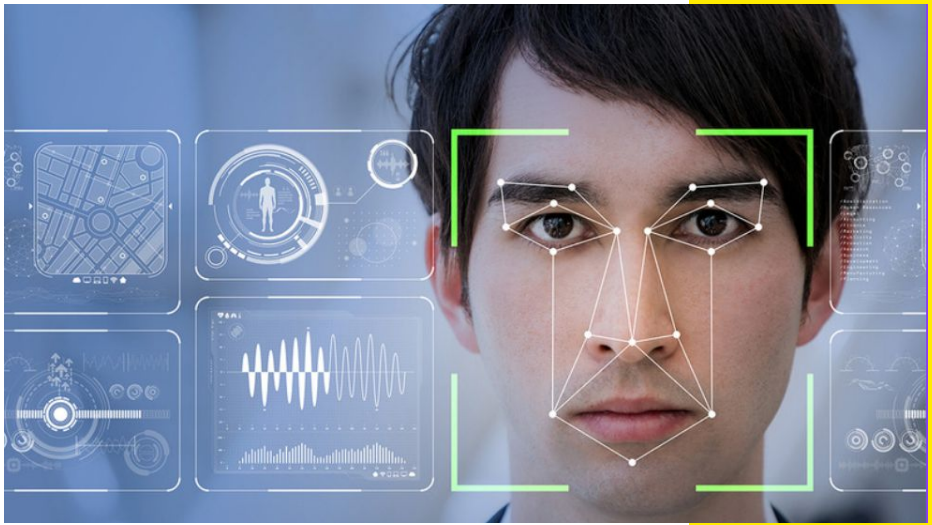


Skip Connections are introduced as part of the ResNet structured

Face Recognition

Face recognition already implemented in many topics, for example:

- surveillance
- attendance or authentication system
- Marketing & retail

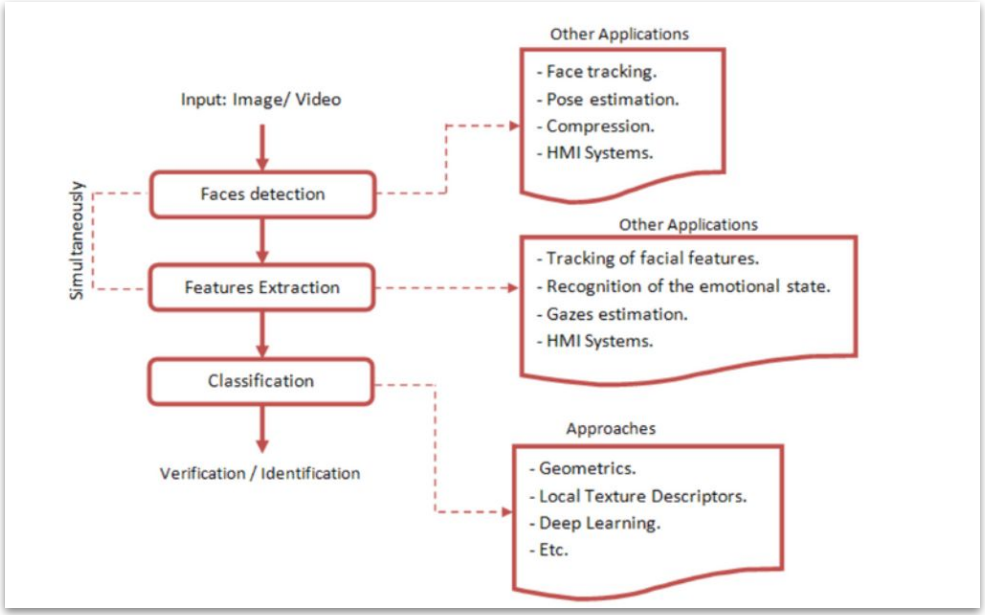


Why Using Face?

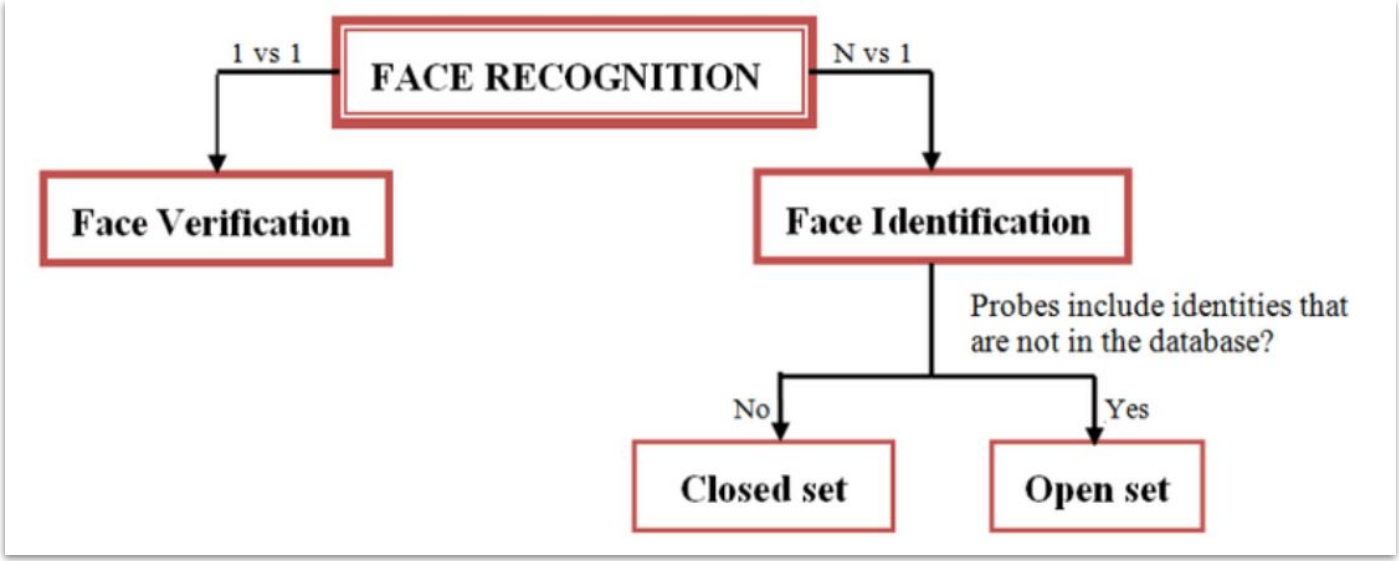
the face has the advantages that make it one of the most favored biometric characteristics for identity recognition, we can note:

- Natural Character
- Nonintrusive
- Less Cooperation

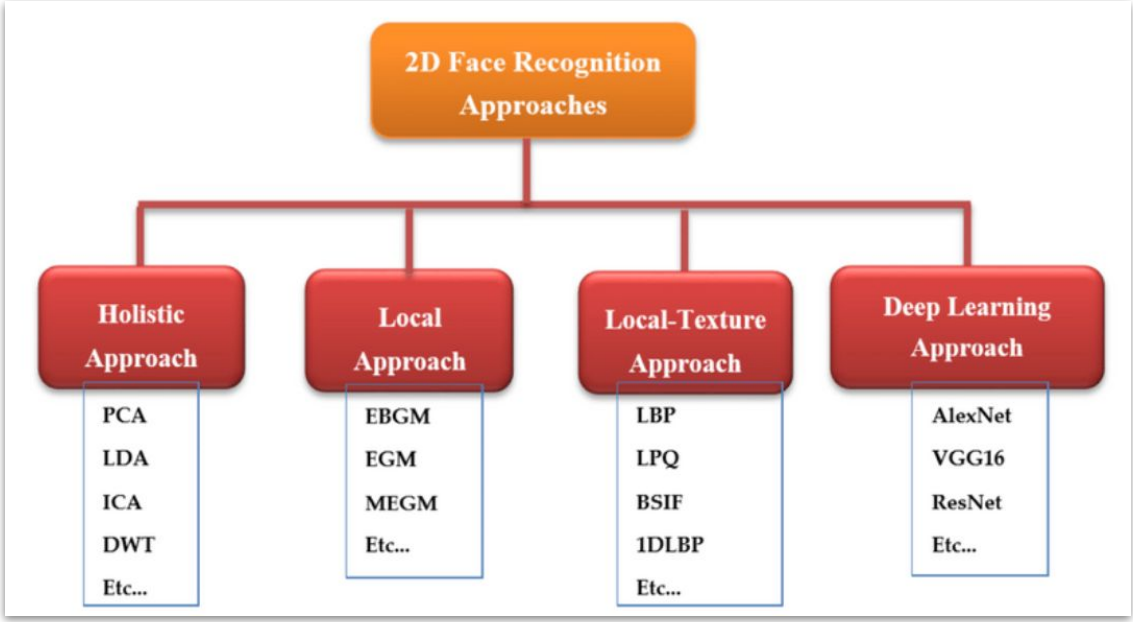
Main Steps in Face Recognition



Assessment Protocols in Face Recognition



Two-Dimentional Face Recognition Approaches



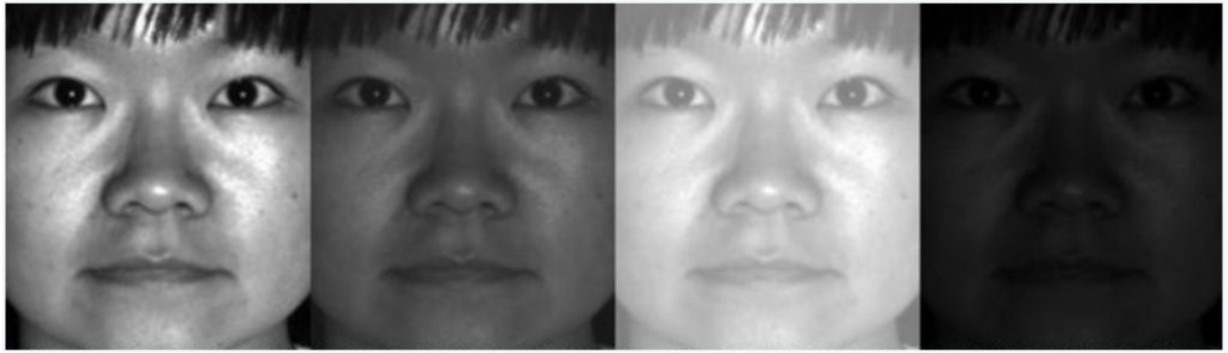
Holistic/Statistical Approaches

The Patterns expressed as features with the goal to choose and apply the right statistical tool for extraction and analysis

- Principal Component Analysis (Eigen Faces)
- Linear Discriminative Analysis (Fisher Faces)
- Independent Component Analysis (ICA)

Eigen Faces (PCA)

Fisher Faces (LDA)

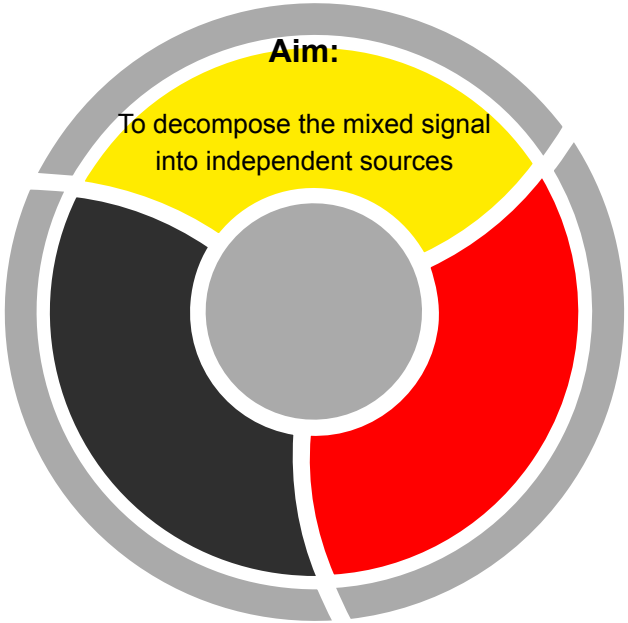


Fisherfaces was introduced which is an improved version of eigenfaces algorithm.

Independent Component Analysis

Aim:

To decompose the mixed signal into independent sources



Problem:

To extract independent sources' signals from a mixed signal composed of the signals from those sources.

Given:

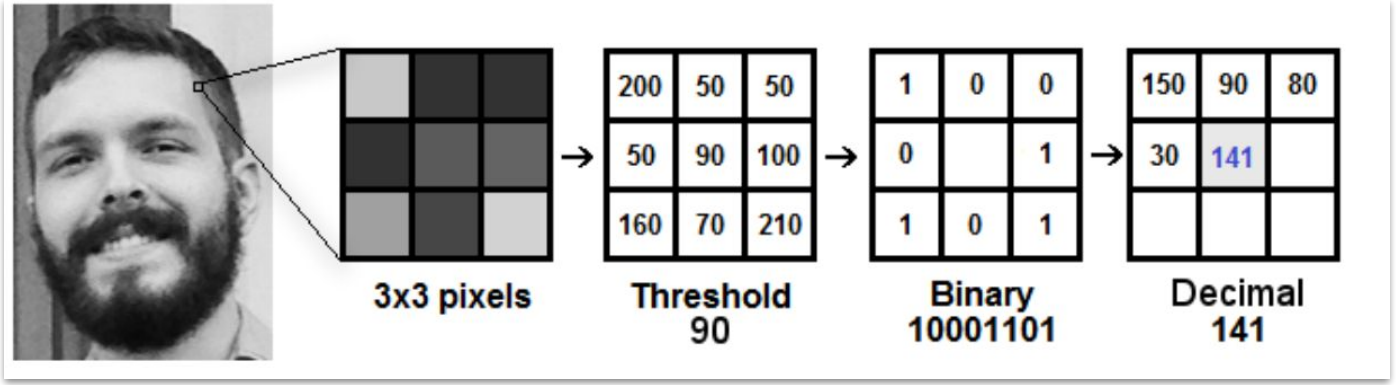
Mixed signal from five different independent sources.

Local Texture Approaches

Feature extraction strategies focused on knowledge about the texture play a significant role in pattern recognition in which suggestions can be divided into statistical and structural.

1. Local Binary Patterns Histograms
2. Local Phase Quantization
3. Binarized Statistical Image Features
4. One-Dimensional Local Binary Pattern

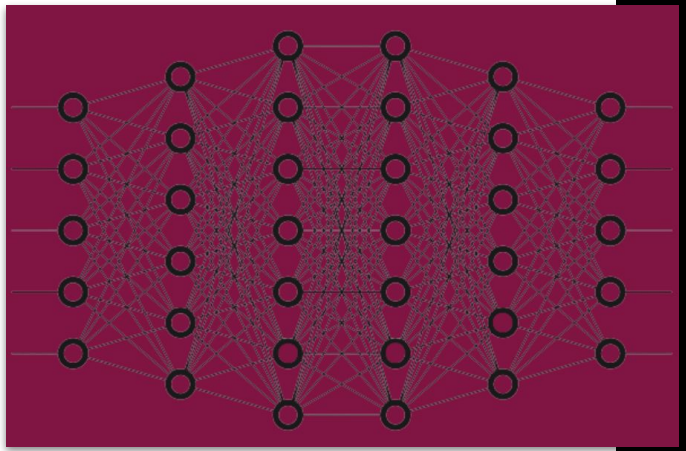
Local Binary Patterns Histograms (LBPH)



Deep Learning Approaches

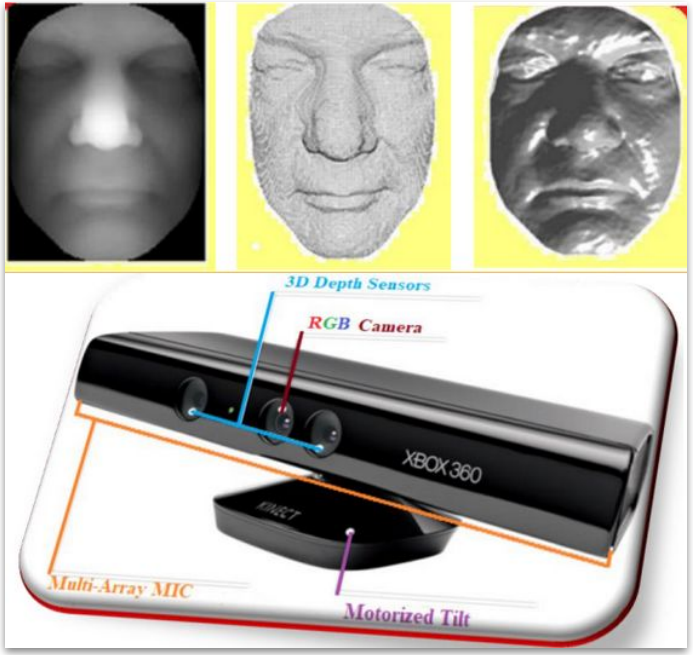
Categorized into three main classes depending on how the technique and architecture is used:

1. Supervised
2. Unsupervised
3. Hybrid

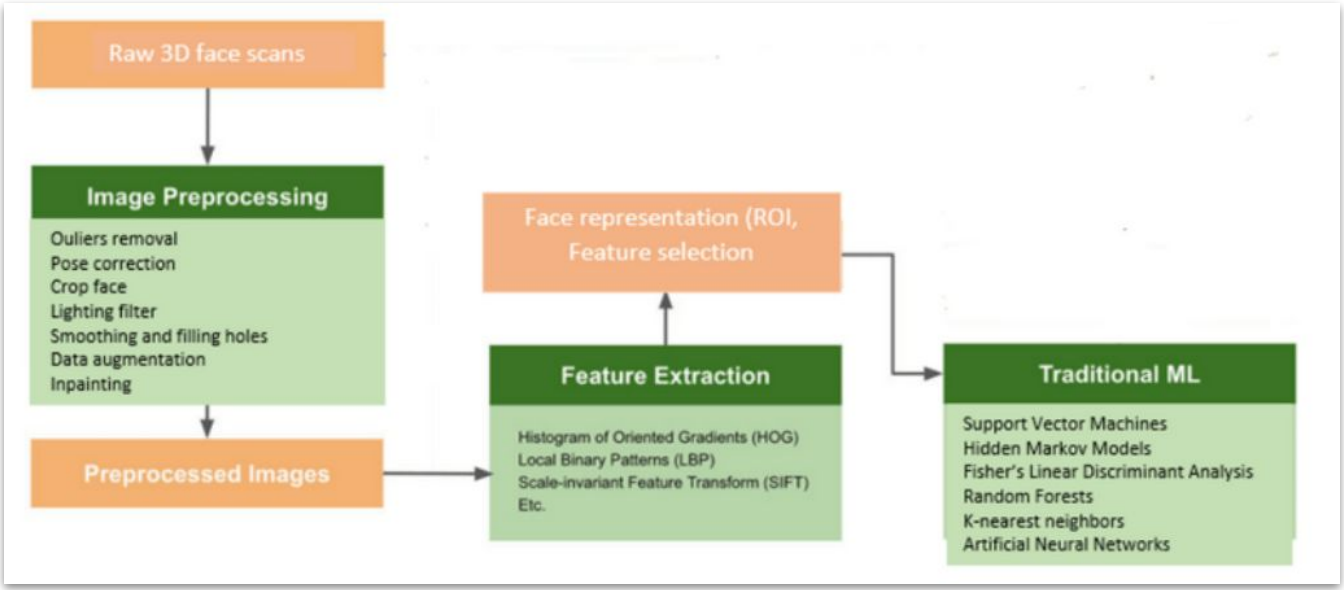


Three-Dimensional Face Recognition

3D facial recognition systems have been developed with the aim of theoretically providing a high level of precision and reliability, and greater immunity to variations in the face due to different factors. Such a capacity is due to more elaborate acquisition systems and to 3D models taking into account the geometric information



Pipeline in 3D Face Recognition



Open Challenges in Near Future

1. Face Recognition and Occlusion
2. Hetegerenous Face Recognition
3. Face Recognition and Ageing
4. Single Sample Face Recognition
5. Face Recognition and Internet of Things

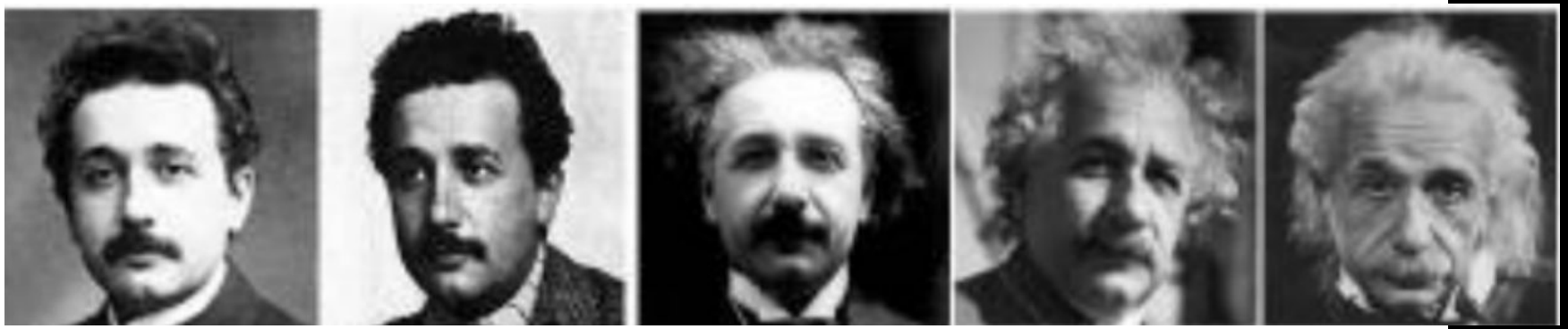
Face Recognition and Occlusion

Some examples of occlusion by hat, glasses, mask, hand, shadow and self occlusion

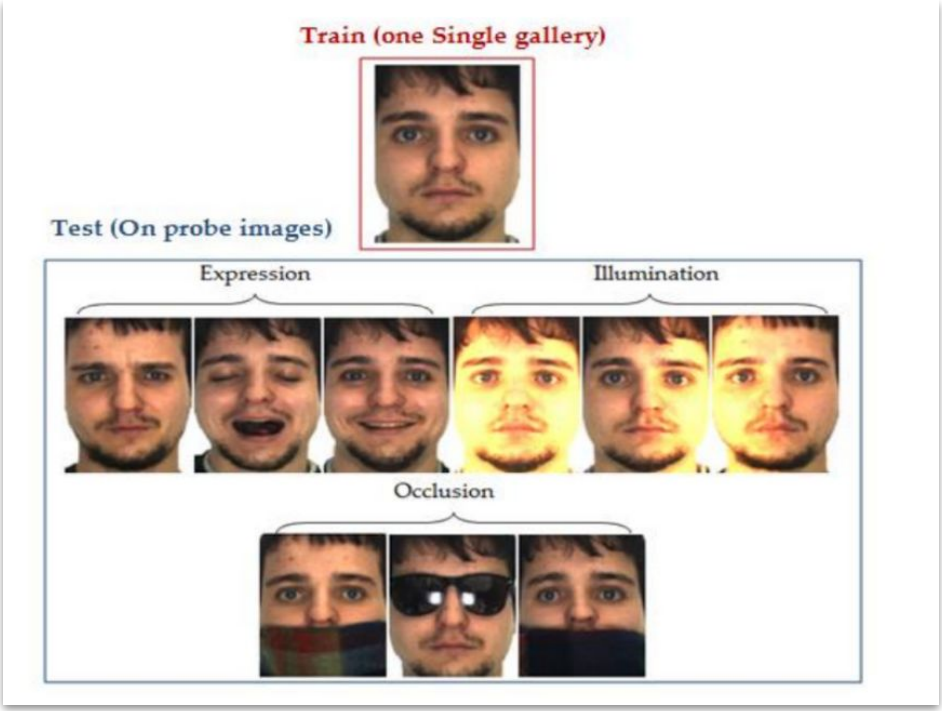
Hetegerenous Face Recognition

Some modalities of imaging display hetegerenous images

Face Recognition and Ageing



Single Sample Face Recognition



Face Recognition and IoT