

FB Face Verification



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Introduction to face recognition

- Face Recognition (FR) has been the prominent biometric technique for identify authentication.
- Widely used in many areas such as military, finance, public security, FB and daily life.
- A facial recognition system in general, work by comparing selected facial features from given image with faces within a database.

Milestones of feature-based FR

○ Four major technical streams:

➤ Holistic learning :

- derive the low dimensional representation through certain distribution assumptions such as linear sub-space, manifold and sparse representation.
- Fails to address uncontrolled facial changes.

➤ Local handcraft :

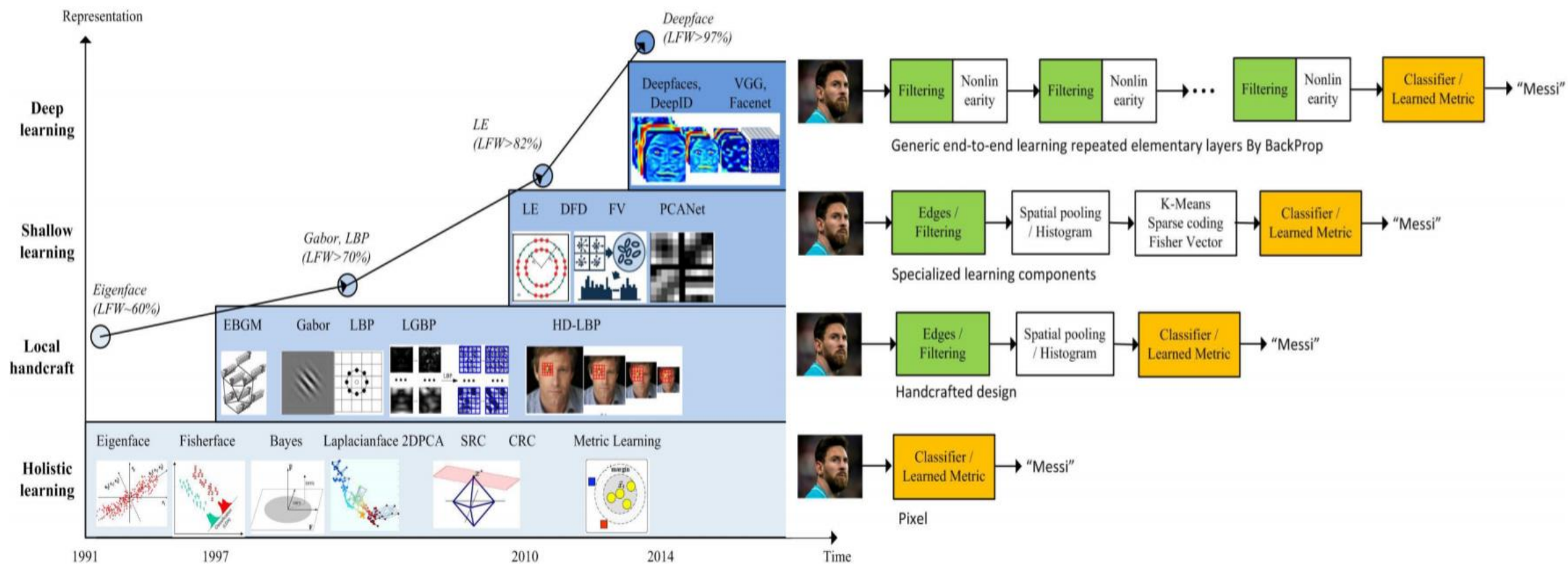
- Gabor and Local Binary Patterns (LBP) as well as their multilevel and high dimensional extensions achieved robust performance through some invariant properties of local filtering.

➤ Shallow learning

- Learning-based local descriptors were introduced.
- Local filtered are learned for better distinctiveness and encoding codebook is learned for better compactness.
- Accuracy of about 95%
- Limitation of complex nonlinear facial appearance variations.

➤ Deep learning:

- In CNN, the lower layers automatically learn the features similar to Gabor and SIFT and the higher layers further learn higher abstraction.
- DeepFace achieved the SOTA accuracy on LFW benchmark of about 97.35%



Component of face recognition

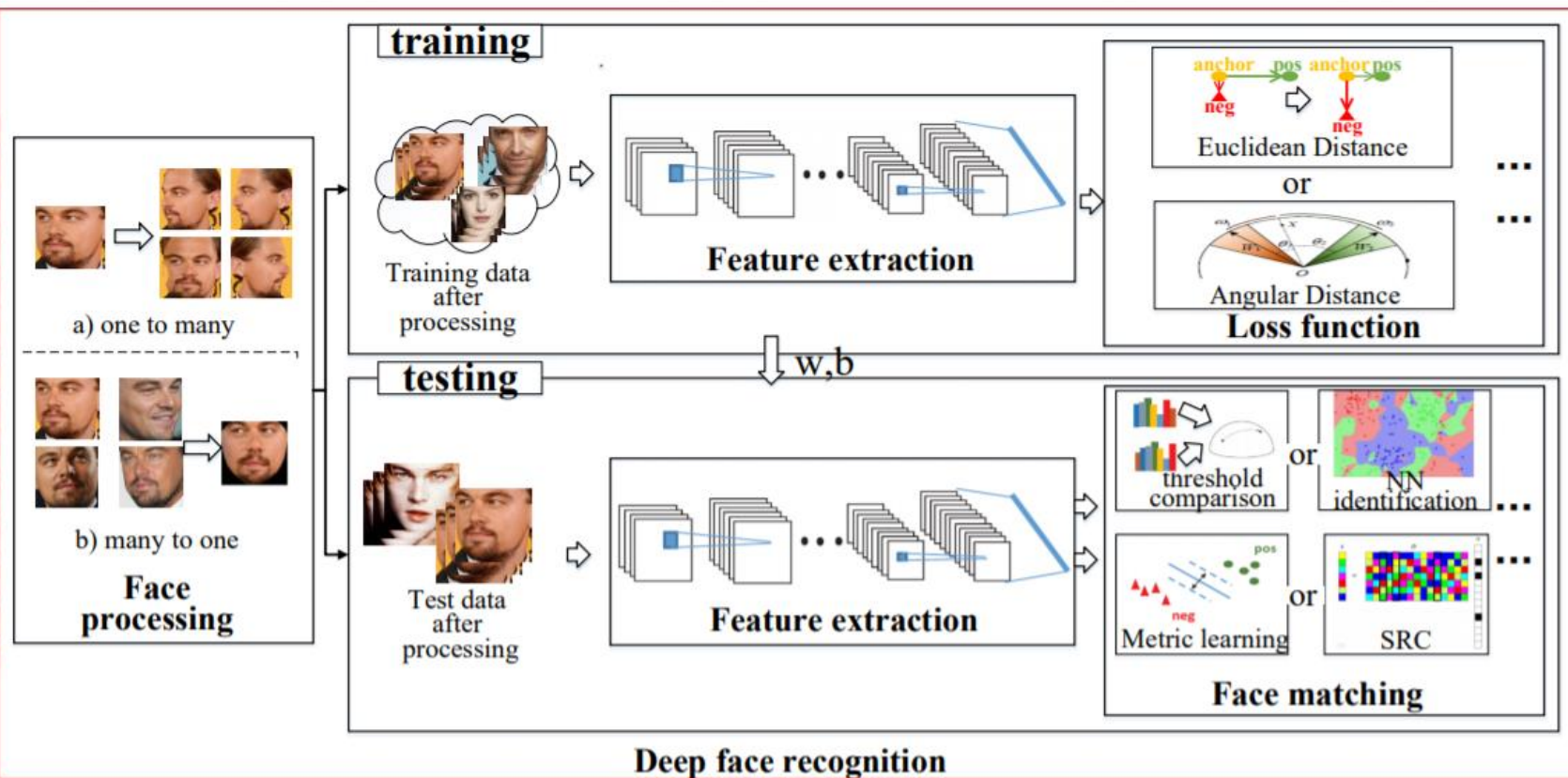
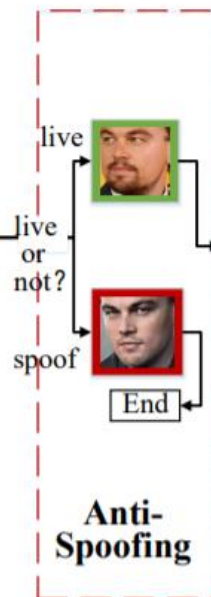
- Face detection: Used to localize faces in images
- Face landmark detector: Aligned to normalized canonical co-ordinates
- FR module
 - Face processing
 - Deep feature extraction
 - Face matching



(a)

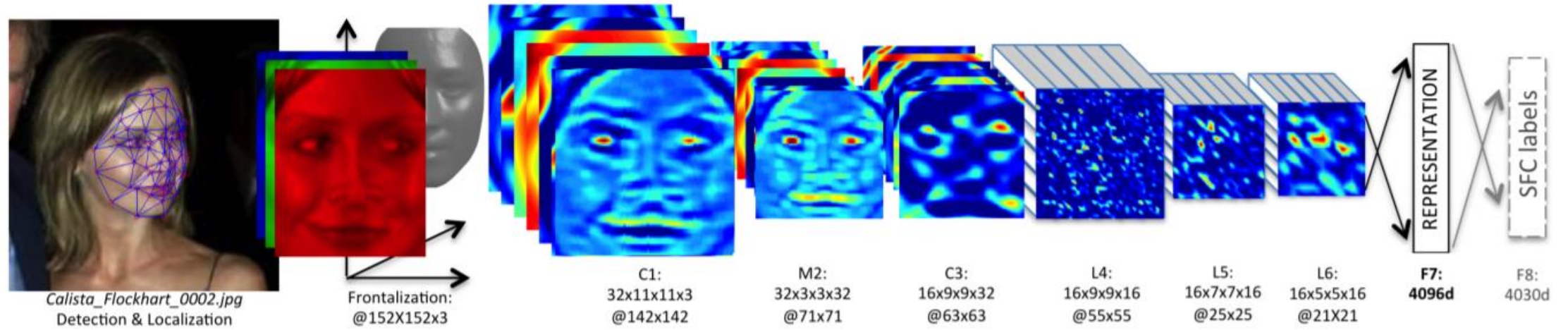


(b)



(c)

Outline of DeepFace architecture



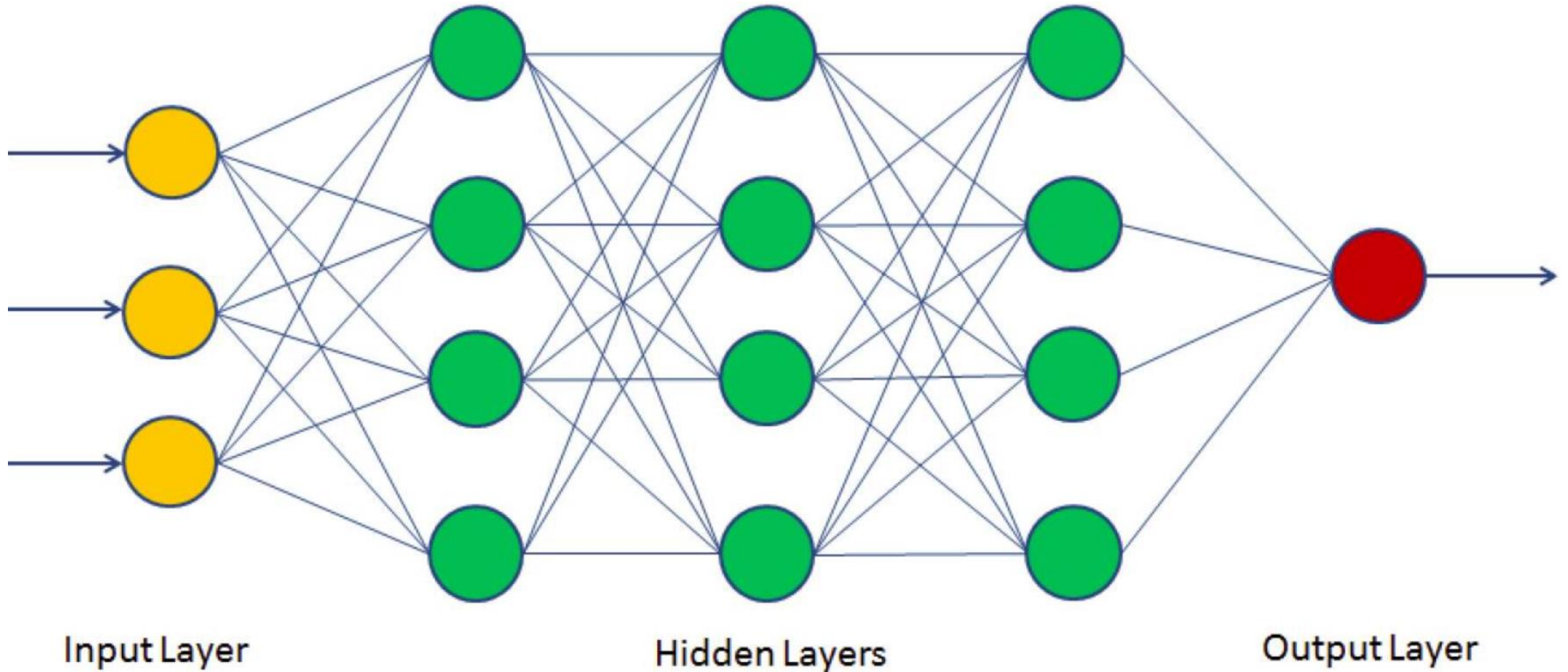
C1- convolution layer

M2- max-pooling layer

L4,L5,L6- locally connected like convolutional layer

- Convolution layer:
 - Sometimes called feature extractor
 - Preserves the spatial relationship between pixels by learning image features using small squares of the input image
- Pooling layer:
 - Used to reduce dimensions with the aim of reducing processing time.
 - Max-pooling searches for the highest value found in the sub-matrix and saves it in the output matrix.

DNN(Deep Neural Network)



Database

- Labeled Faces in the Wild (LFW) dataset:
 - Consists of 13,323 web photos of 5749 celebrities which are divided into 6000 face pairs in 10 splits.
 - The mean recognition accuracy on LFW is 97.5%

THE ACCURACY OF DIFFERENT METHODS EVALUATED ON THE LFW DATASET.

Method	Public. Time	Loss	Architecture	Number of Networks	Training Set	Accuracy \pm Std(%)
DeepFace [20]	2014	softmax	Alexnet	3	Facebook (4.4M,4K)	97.35 \pm 0.25
DeepID2 [21]	2014	contrastive loss	Alexnet	25	CelebFaces+ (0.2M,10K)	99.15 \pm 0.13
DeepID3 [36]	2015	contrastive loss	VGGNet-10	50	CelebFaces+ (0.2M,10K)	99.53 \pm 0.10
FaceNet [38]	2015	triplet loss	GoogleNet-24	1	Google (500M,10M)	99.63 \pm 0.09
Baidu [58]	2015	triplet loss	CNN-9	10	Baidu (1.2M,18K)	99.77
VGGface [37]	2015	triplet loss	VGGNet-16	1	VGGface (2.6M,2.6K)	98.95
light-CNN [85]	2015	softmax	light CNN	1	MS-Celeb-1M (8.4M,100K)	98.8
Center Loss [101]	2016	center loss	Lenet+-7	1	CASIA-WebFace, CACD2000, Celebrity+ (0.7M,17K)	99.28
L-softmax [104]	2016	L-softmax	VGGNet-18	1	CASIA-WebFace (0.49M,10K)	98.71
Range Loss [82]	2016	range loss	VGGNet-16	1	MS-Celeb-1M, CASIA-WebFace (5M,100K)	99.52
L2-softmax [109]	2017	L2-softmax	ResNet-101	1	MS-Celeb-1M (3.7M,58K)	99.78
Normface [110]	2017	contrastive loss	ResNet-28	1	CASIA-WebFace (0.49M,10K)	99.19
CoCo loss [112]	2017	CoCo loss	-	1	MS-Celeb-1M (3M,80K)	99.86
vMF loss [115]	2017	vMF loss	ResNet-27	1	MS-Celeb-1M (4.6M,60K)	99.58
Marginal Loss [116]	2017	marginal loss	ResNet-27	1	MS-Celeb-1M (4M,80K)	99.48
SphereFace [84]	2017	A-softmax	ResNet-64	1	CASIA-WebFace (0.49M,10K)	99.42
CCL [113]	2018	center invariant loss	ResNet-27	1	CASIA-WebFace (0.49M,10K)	99.12
AMS loss [105]	2018	AMS loss	ResNet-20	1	CASIA-WebFace (0.49M,10K)	99.12
Cosface [107]	2018	cosface	ResNet-64	1	CASIA-WebFace (0.49M,10K)	99.33
Arcface [106]	2018	arcface	ResNet-100	1	MS-Celeb-1M (3.8M,85K)	99.83
Ring loss [117]	2018	Ring loss	ResNet-64	1	MS-Celeb-1M (3.5M,31K)	99.50

Thank You !!