ClusterFace: Joint Clustering and Classification for Set-Based Face Recognition

25th International Conference on Pattern Recognition (ICPR2020)
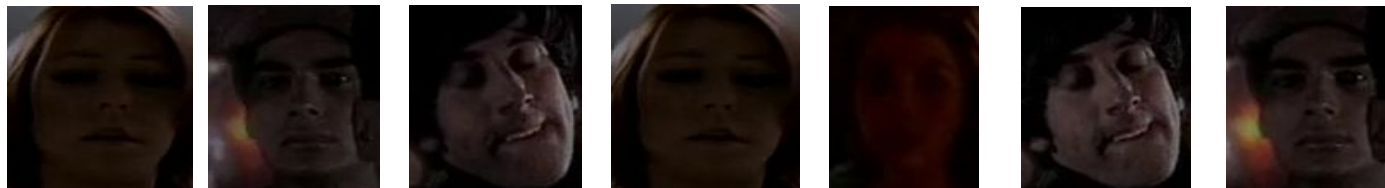
Samadhi Wickrama Arachchilage and
Ebroul Izquierdo

Multimedia and Vision Research Group,
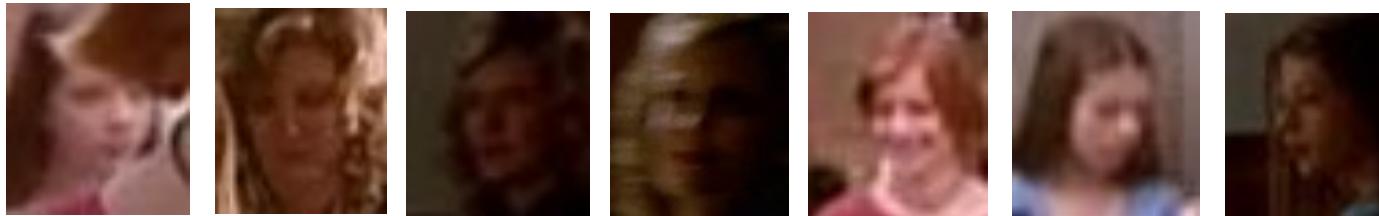Queen Mary University of London

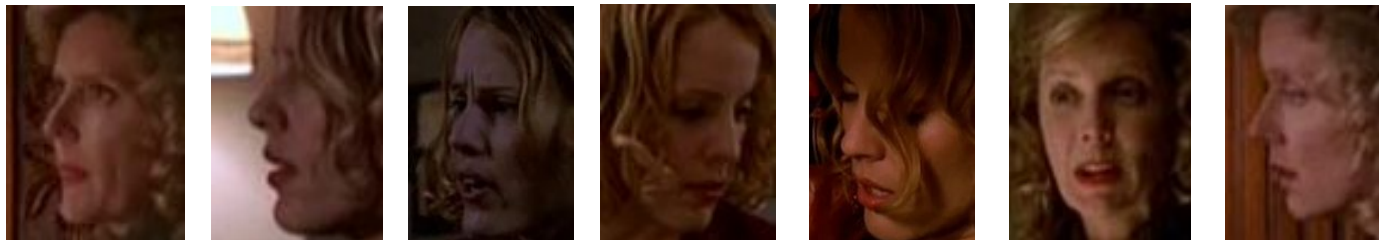# Faces captured under unconstrained variations

Poor illumination

Poor sensor quality/ Low resolution from full shots

Pose variations
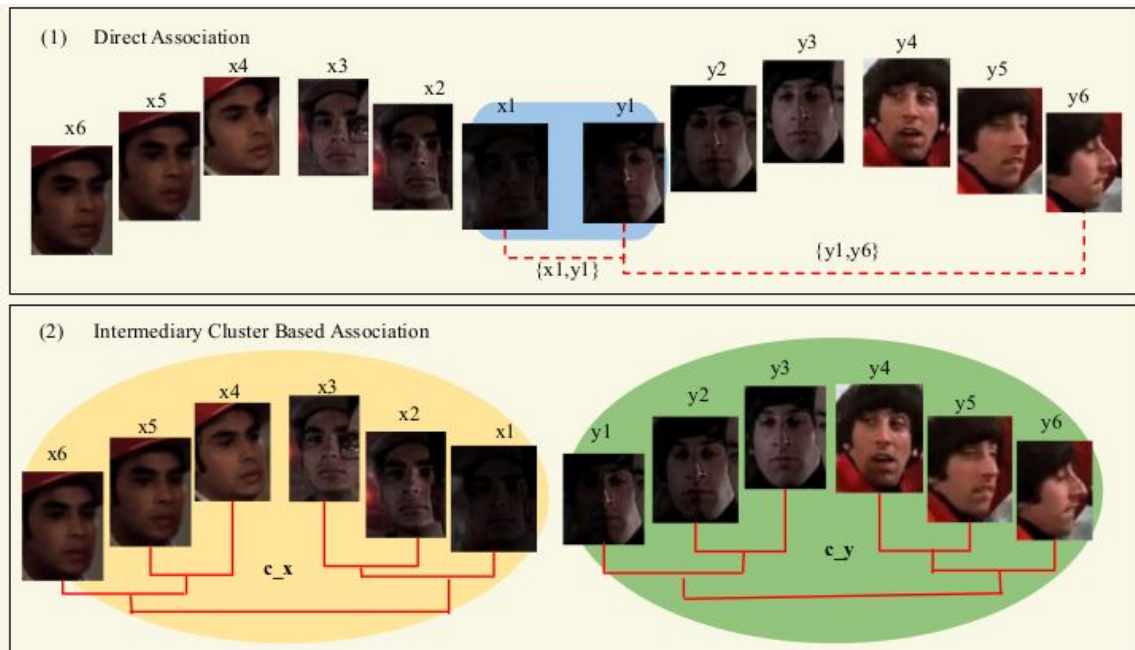
ClusterFace

Problem Statement

Figure: $x1, ..x6$ are faces of individual x and $y1, ..., y6$ are of individual y. c_x denotes cluster x and c_y denotes cluster y. Dashed lines show direct associations, solid lines show ClusterFace associations. **Top**: Direct associations incorrectly conclude that x1 and y1 (faces of different individuals under similar illumination conditions) are more similar than y1 and y6 (faces of same individual under different settings). **Bottom**: ClusterFace associations begin by merging the closest faces. Gradual and incremental associations correctly group the samples of same individual in to a single cluster.

Related Work

Unconstrained Face Recognition: Previous Work

| Powerful face descriptors.	● Advanced deep learning technology ● Sufficient and diversified train data
Adaptive facial models.	● Single or multiple classifiers (e.g: SVM) updated based on face tracking result. ● Applicable only on videos
Co-Training	● Training multiple classifiers where classifiers guide each other based on confident predictions. ● Require labelled data to initiate the classifiers
ClusterFace	● Easy-to-hard neighbourhood analysis based on confident clusters. ● Does not require supervision from test data.

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Must Associate (MA) and Neighbourhood Associate (NA) Constraints
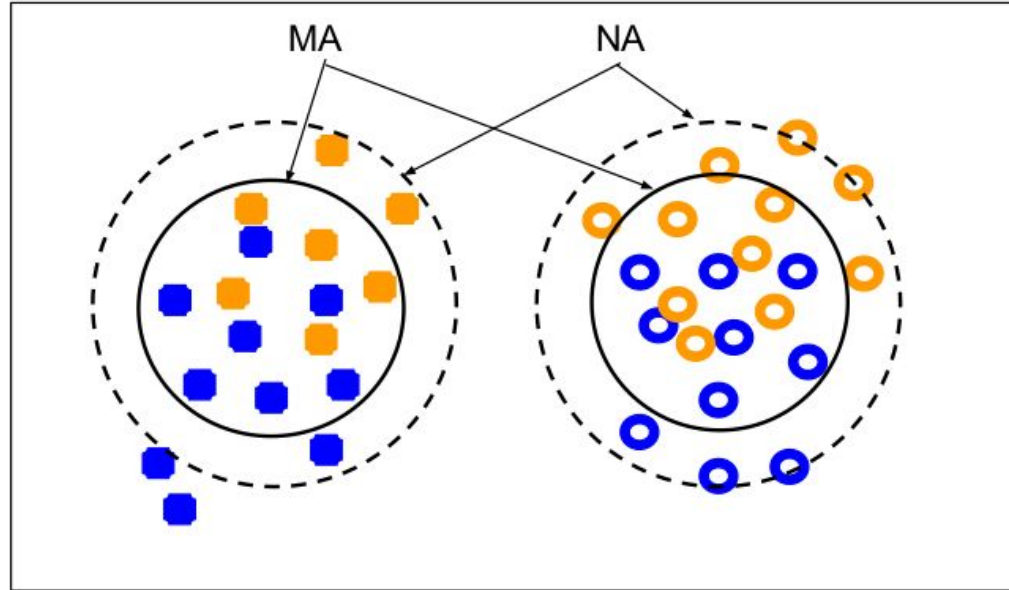
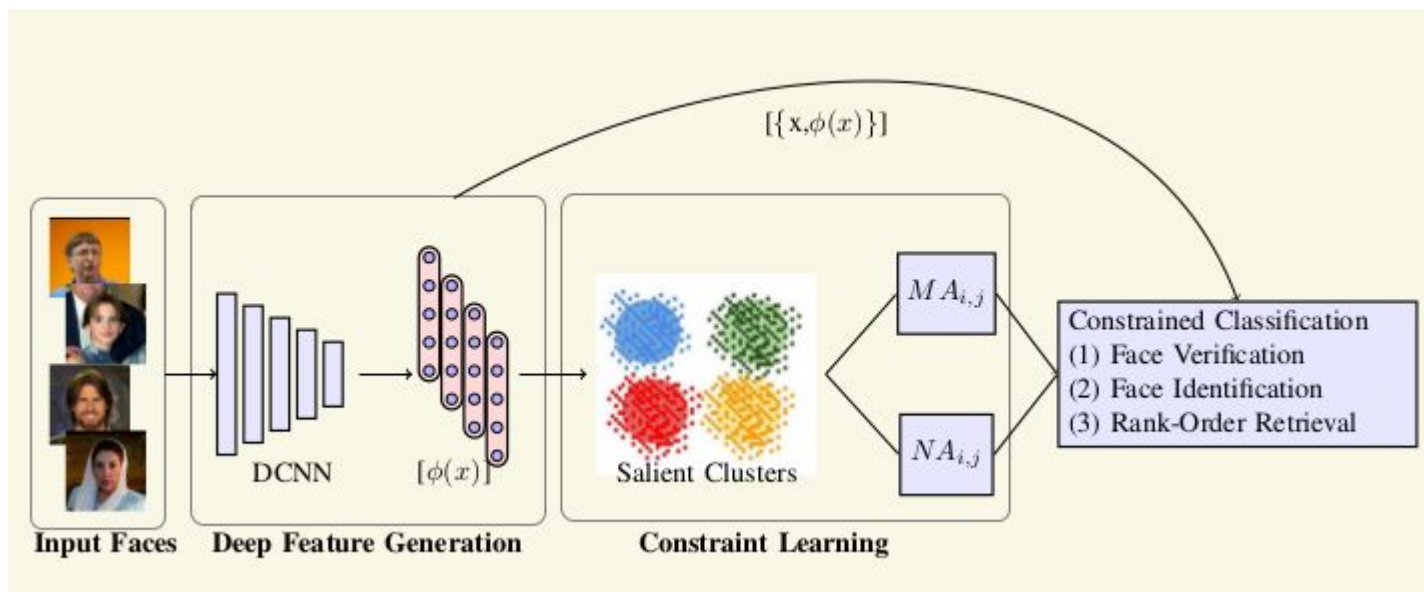# Framework Overview

Hierarchical Agglomerative Clustering (HAC)

Hierarchical clustering

- Preserves high reliability in early iterations

Clustering step

- Replace the image set with its centroid.
- Link centroids with hierarchical agglomeration

Computational complexity

- Conventional HAC : $O(n^3)$
- ClusterFace clustering : $O(s^2 log(s))$
  where s is the number of sets and s << n

Performance Evaluation

Performance Evaluation

IJB-A verification (TAR)			
System	FAR=0.001	FAR=0.01	FAR=0.1
Triplet Emb	81.3	91	96.4
FastSearch	51.0	72.9	89.3
Joint Bayesian	-	83.8	96.7
PAM	65.2	82.6	-
NAN	88.1	94.1	97.8
Template	83.6	93.9	97.9
DR GAN	53.9	77.4	-
Direct Associations	84.95	93.76	98.13
ClusterFace Associations	86.60	94.23	98.30

IJB-A closed-set face recognition			
System	Rank-1	Rank-5	Rank-10
Triplet Emb	93.2	-	97.7
FastSearch	82.2	93.1	-
Joint Bayesian	90.3	96.5	97.7
PAM	84	92.5	94.6
NAN	95.8	98.0	98.6
Template	92.8	97.7	98.6
DR GAN	85.5	94.7	-
Direct Associations	94.23	97.05	97.71
ClusterFace Associations	94.28	97.05	97.72

System	YTC Accuracy (%)
SANP	65.60
MMDML	78.5
DRM-PWV	72.55
Fast FR	72.1
GJRNP	81.3
Direct Associations	90.71
ClusterFace Associations	91.06

Thank you