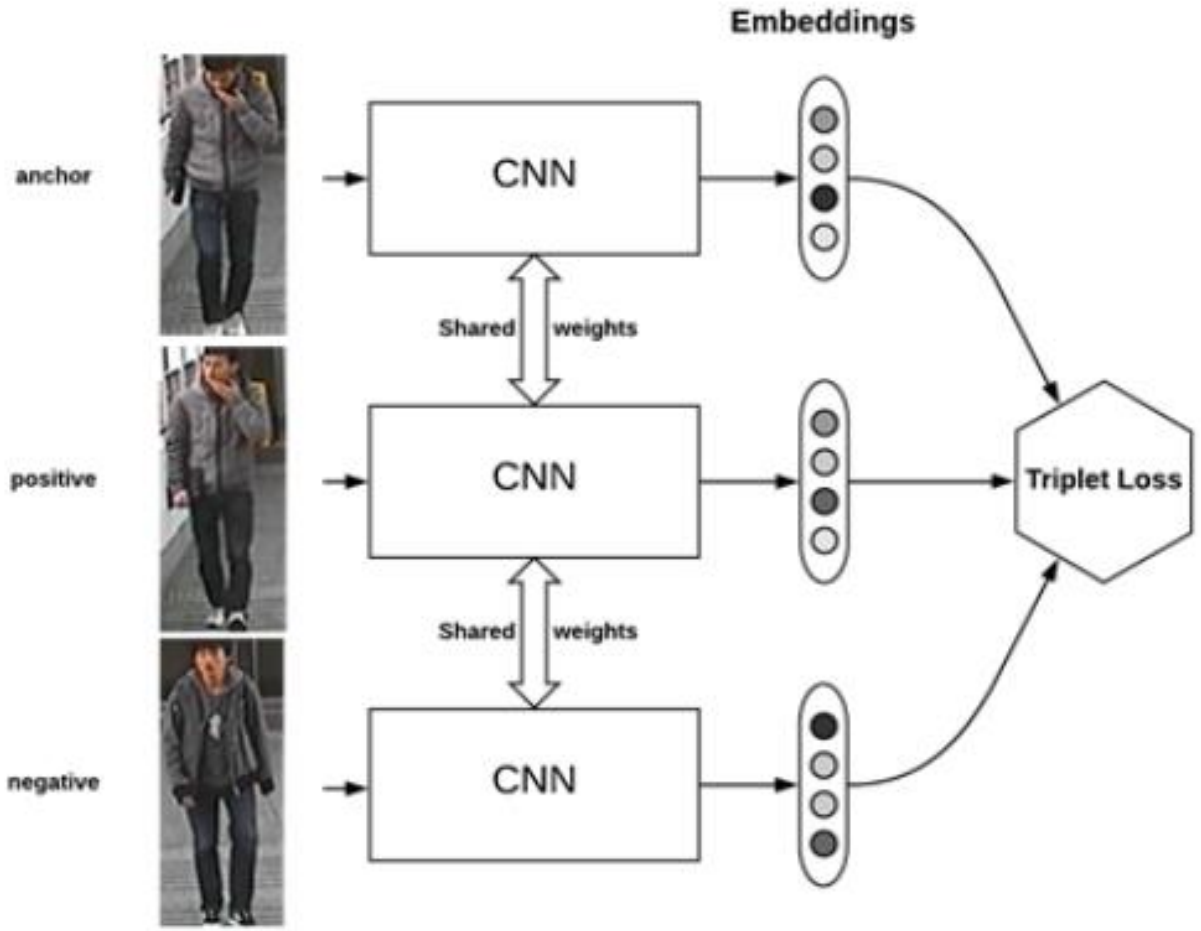
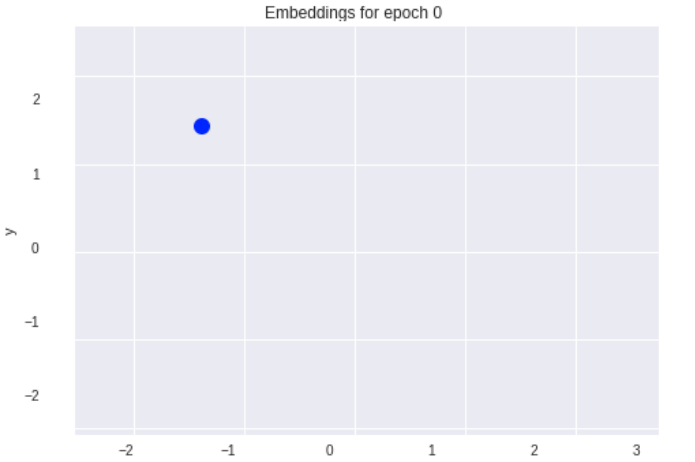
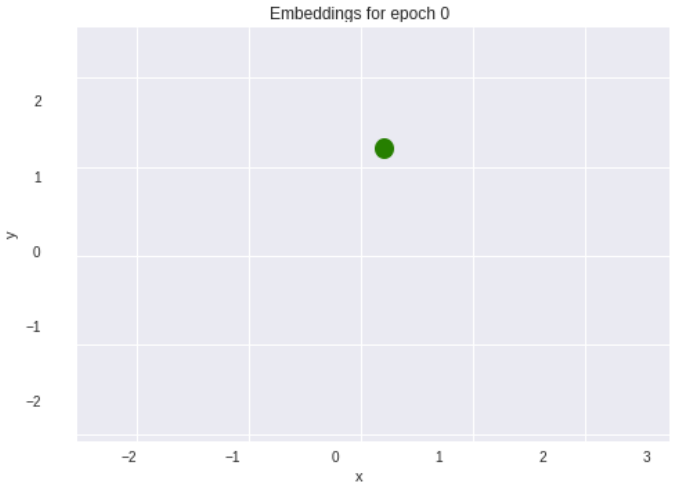
DEEP MULTI-STREAM CONVOLUTIONAL NEURAL NETWORKS IN HUMAN RE-ID

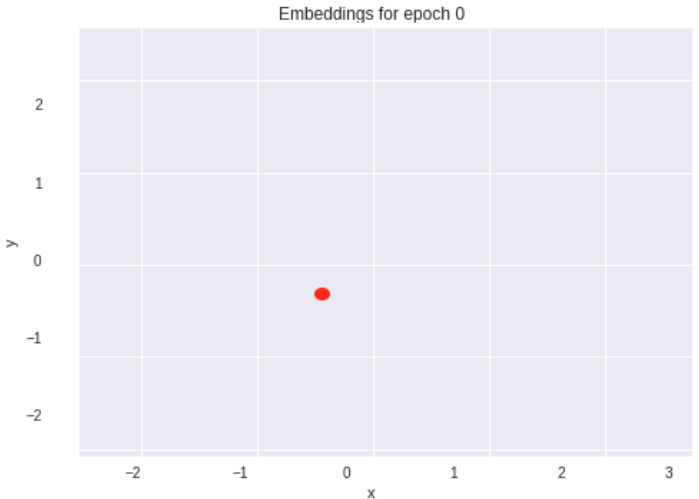
A new Architecture for improved Human Re-ID

TRIPLET LOSS RECAP

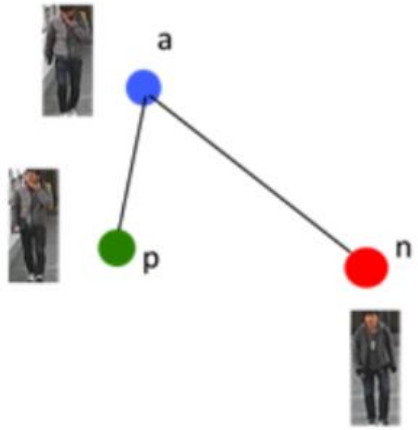


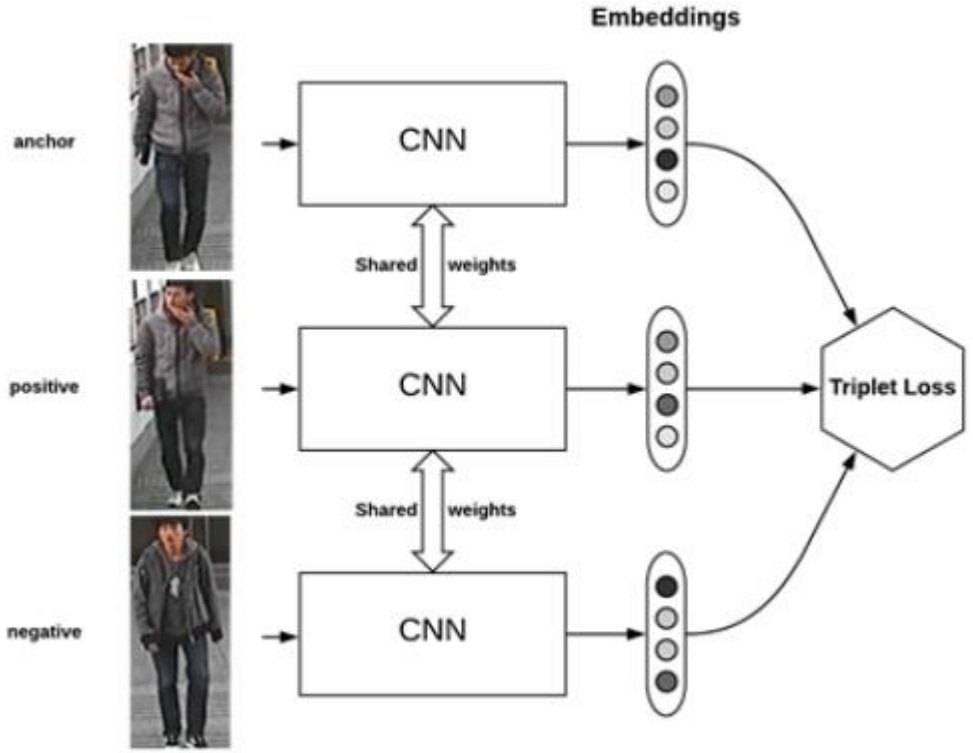


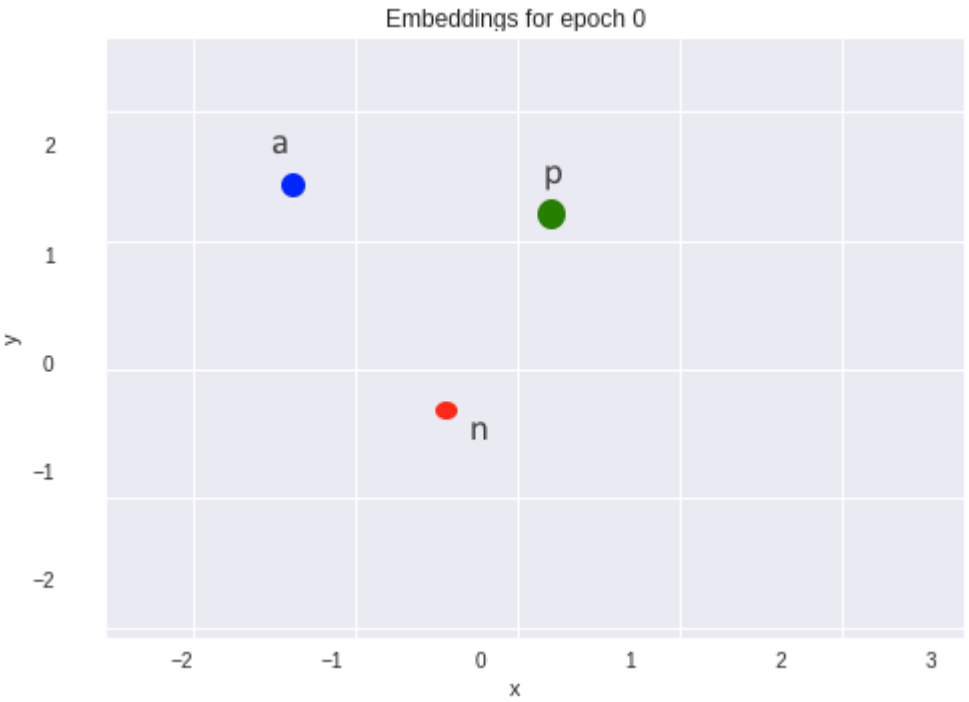




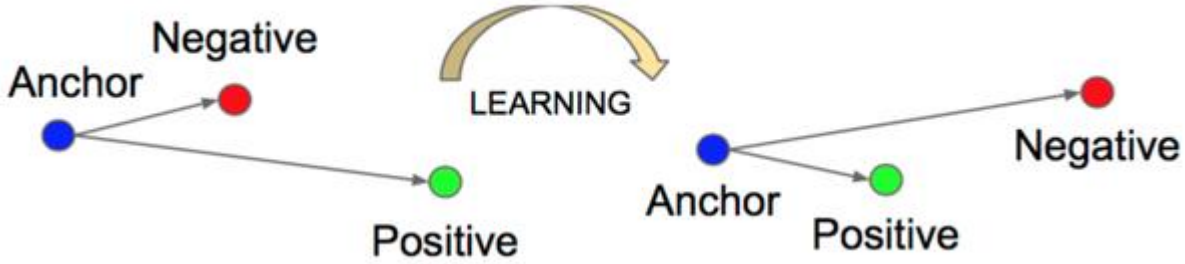
EMBEDDINGS (DISTANCE, SIMILARITY)

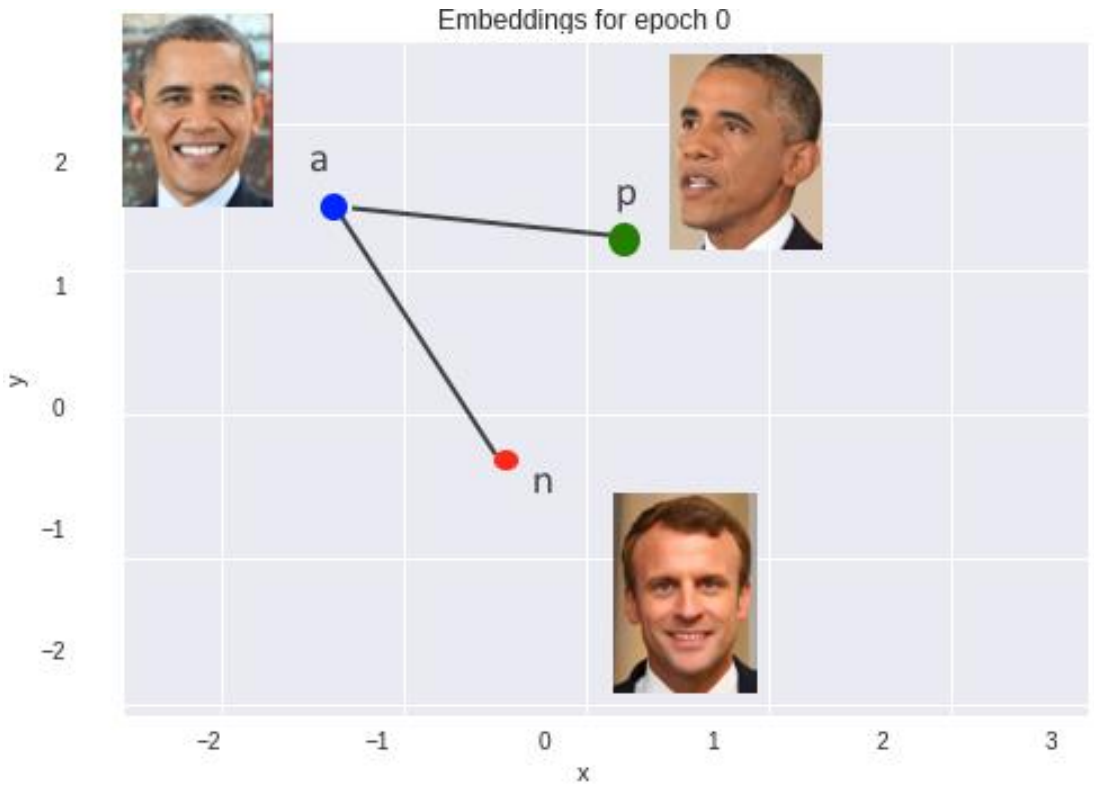






TRIPLET LOSS





$$\|f_a - f_p\|_2^2 \leq \|f_a - f_n\|_2^2$$

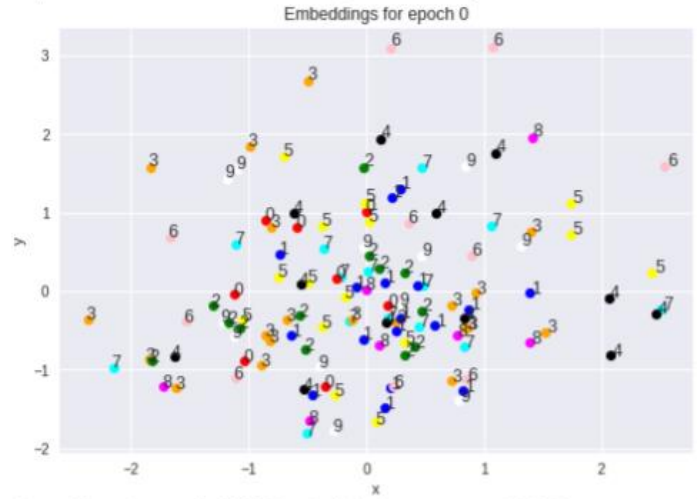
$$\|f_a - f_p\|_2^2 - \|f_a - f_n\|_2^2 \leq 0$$

$$\|f_a - f_p\|_2^2 - \|f_a - f_n\|_2^2 + \alpha \leq 0$$

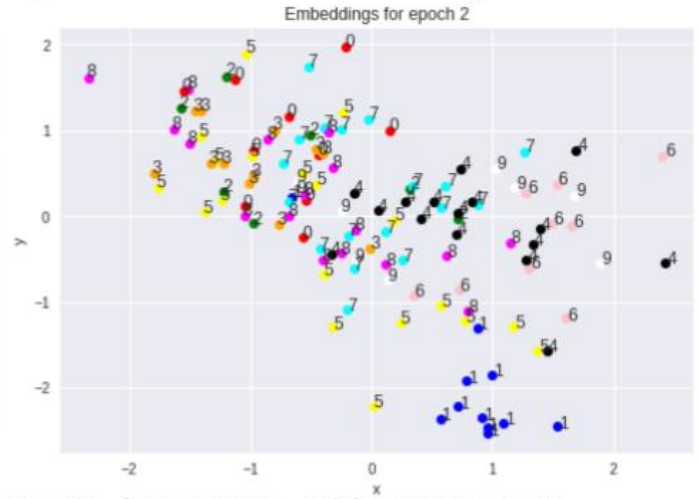
$$L(a, p, n) = max(\|f_a - f_p\|_2^2 - \|f_a - f_n\|_2^2 + \alpha, 0)$$

TRAINING OF TRIPLET LOSS

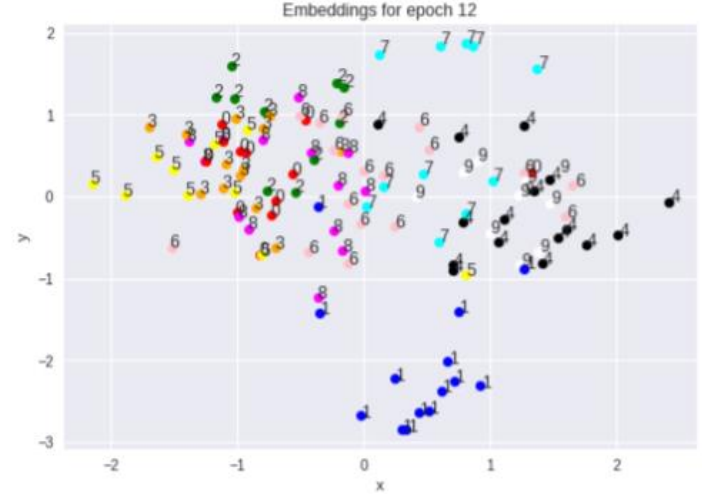
step 0: loss: 0.851599 triplet-accuracy: 0.453



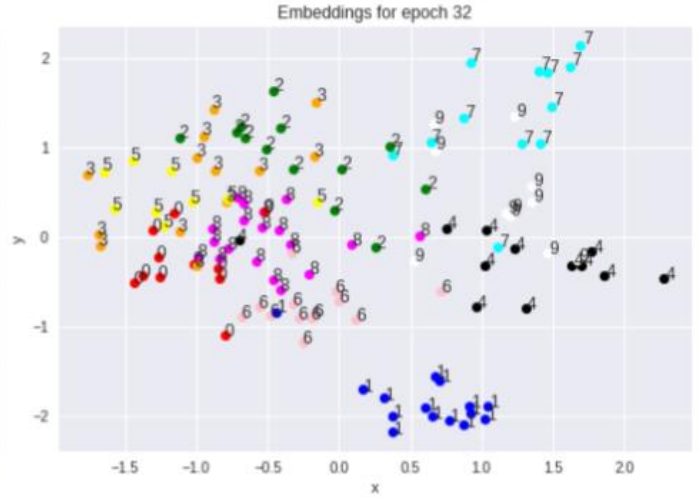
step 2: loss: 0.461718 triplet-accuracy: 0.633



step 12: loss: 0.242393 triplet-accuracy: 0.688



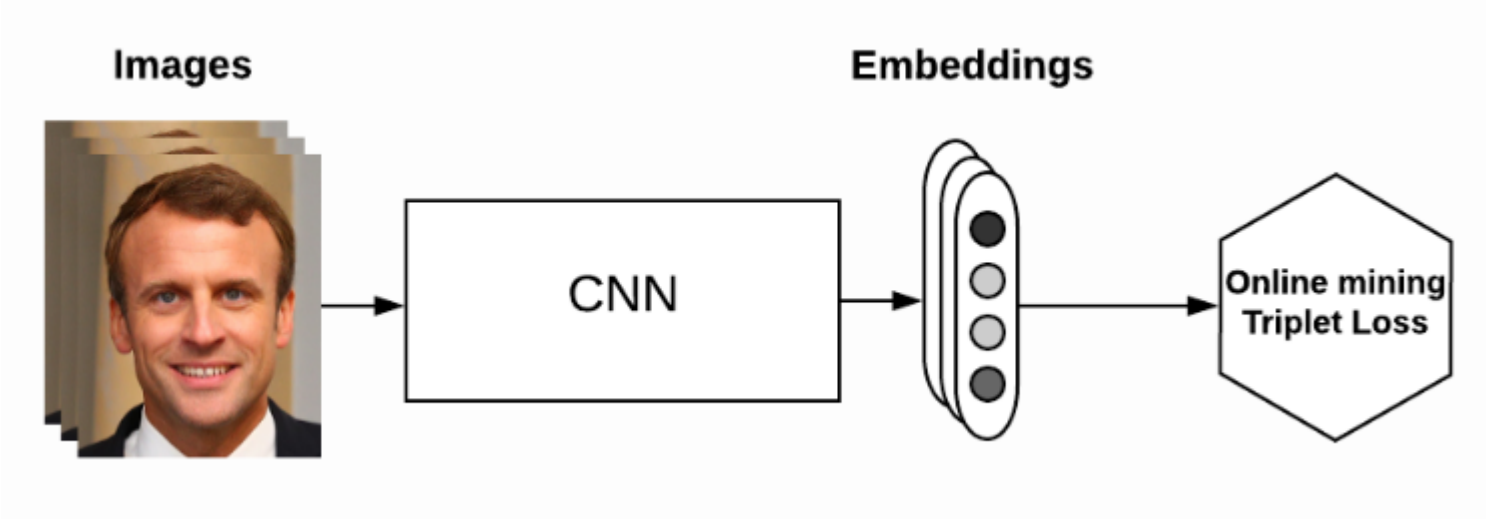
step 32: loss: 0.111763 triplet-accuracy: 0.797



ONLINE TRIPLETS & BATCH ALL

Very cost intensive

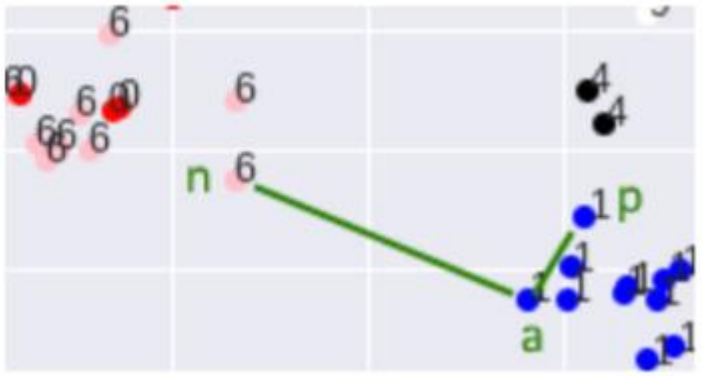
Batch means that all possible Triplets are generated



HARD TRIPLETS & HARD TRIPLET MINING

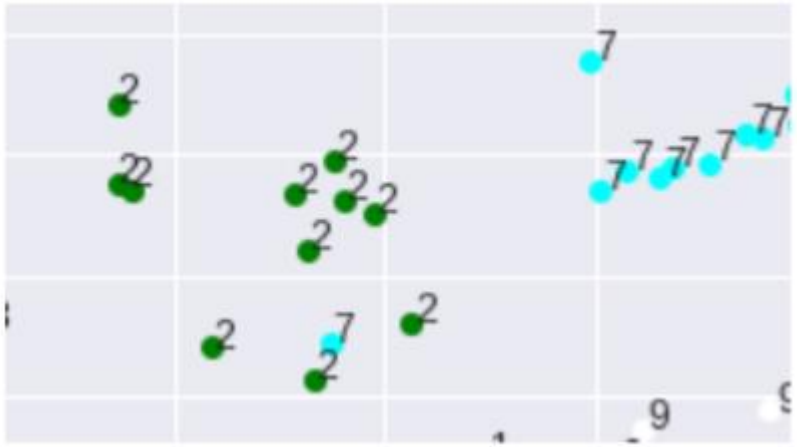
Easy Triplet

Network doesn't learn much

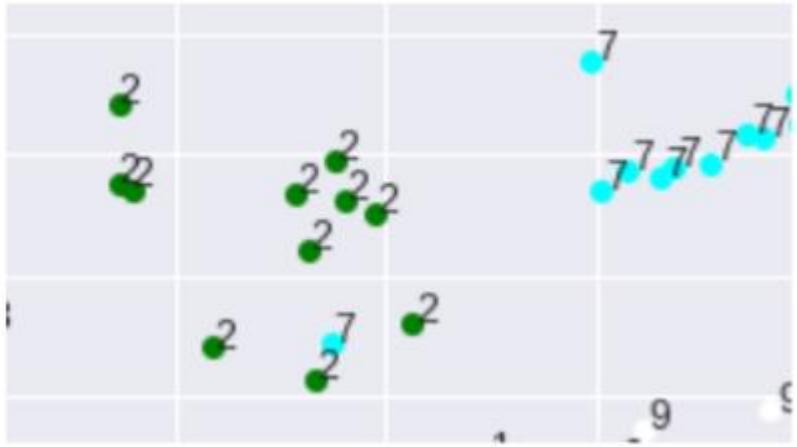


Hard Triplet

Network learns faster



HARD TRIPLET MINING



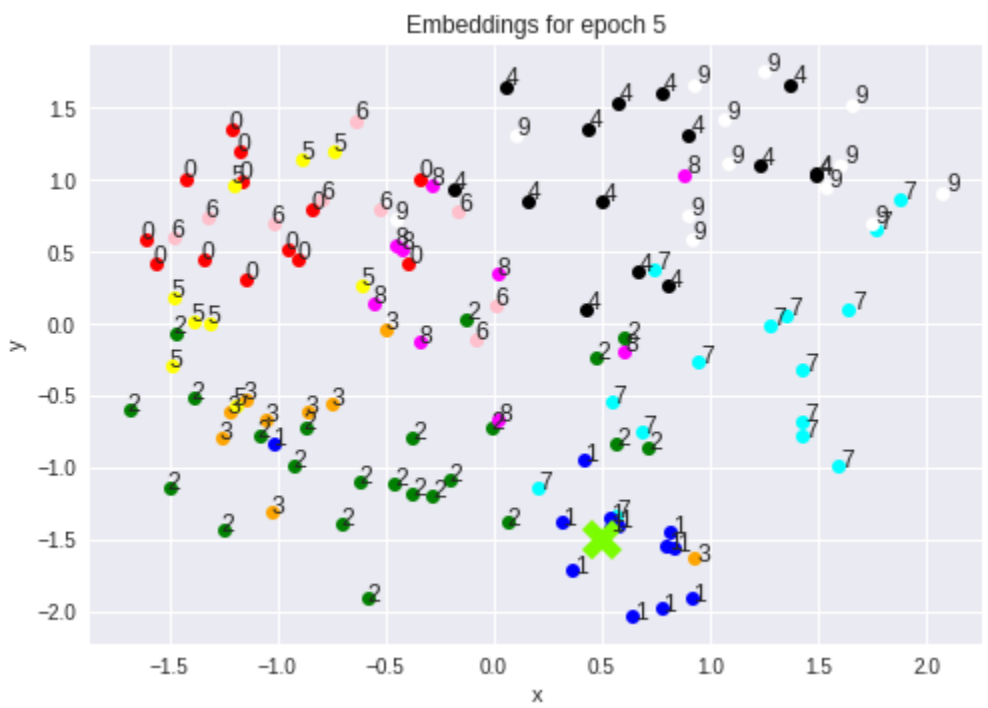
- Using distance matrix for all points in a batch (e.g. 128 embeddings) [128,128]

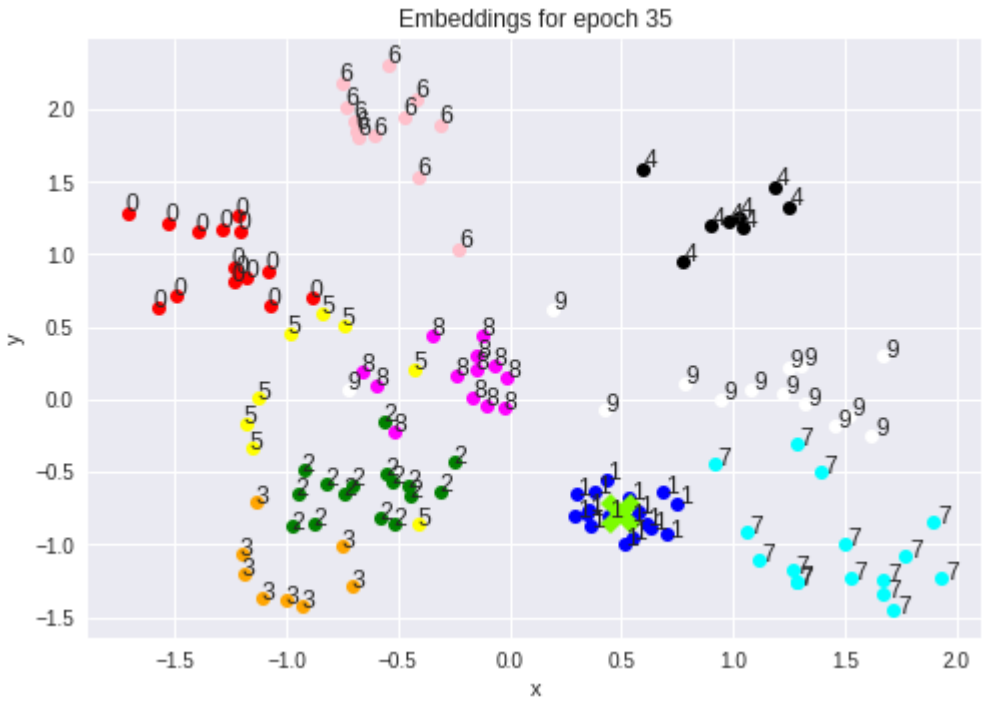
- Taking maximum of rows for each in order to find points which are not in their cluster

Dist	A	B	C	D	E	F
A	0.00	0.71	5.66	3.61	4.24	3.20
B	0.71	0.00	4.95	2.92	3.54	2.50
C	5.66	4.95	0.00	2.24	1.41	2.50
D	3.61	2.92	2.24	0.00	1.00	0.50
E	4.24	3.54	1.41	1.00	0.00	1.12
F	3.20	2.50	2.50	0.50	1.12	0.00

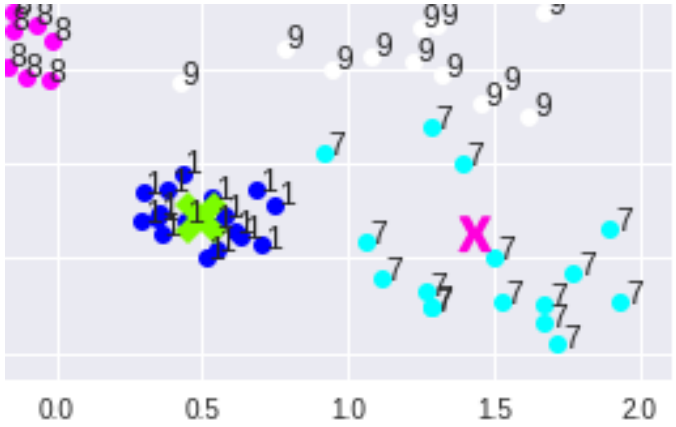
PROPOSED NEW LOSS FUNCTION

Using center of gravity of each cluster for online training





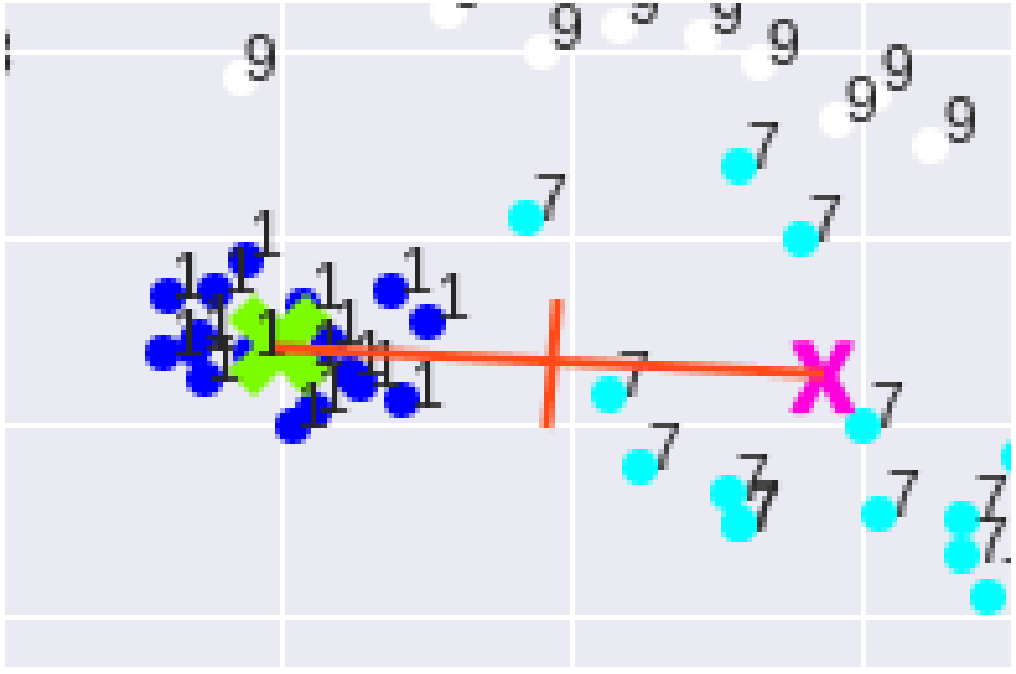
NEW LOSS FUNCTION

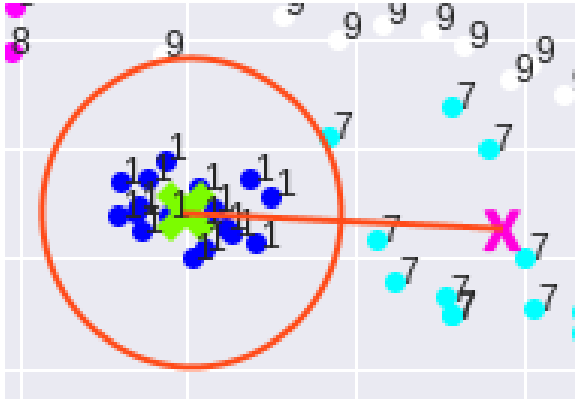


1. Get Center of Gravity for each cluster (for each identity/label)

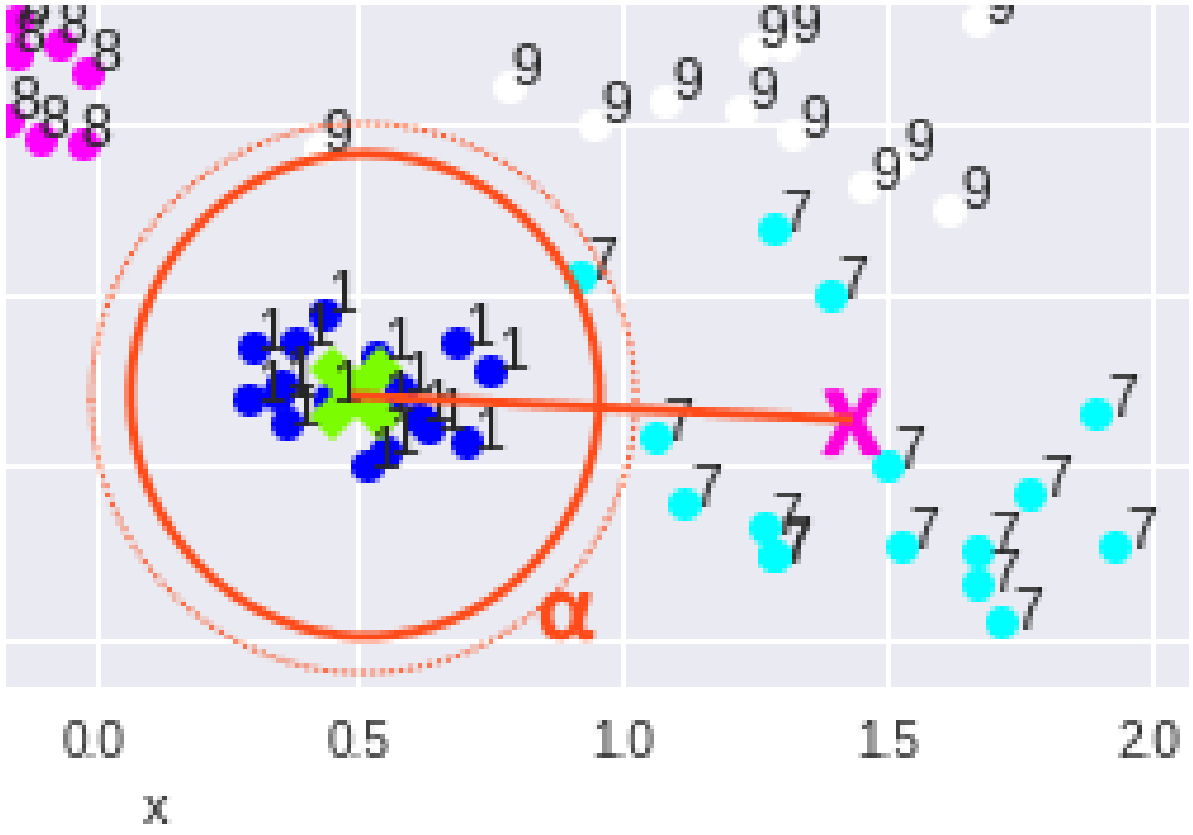
2. Create Distance Matrix just with Center of Gravity

3. Loss function: points of cluster must be nearer to their Center of Gravity then To the closest different center of gravity





NEW LOSS FUNCTION: CENTER OF GRAVITY



The Average point is less distant from

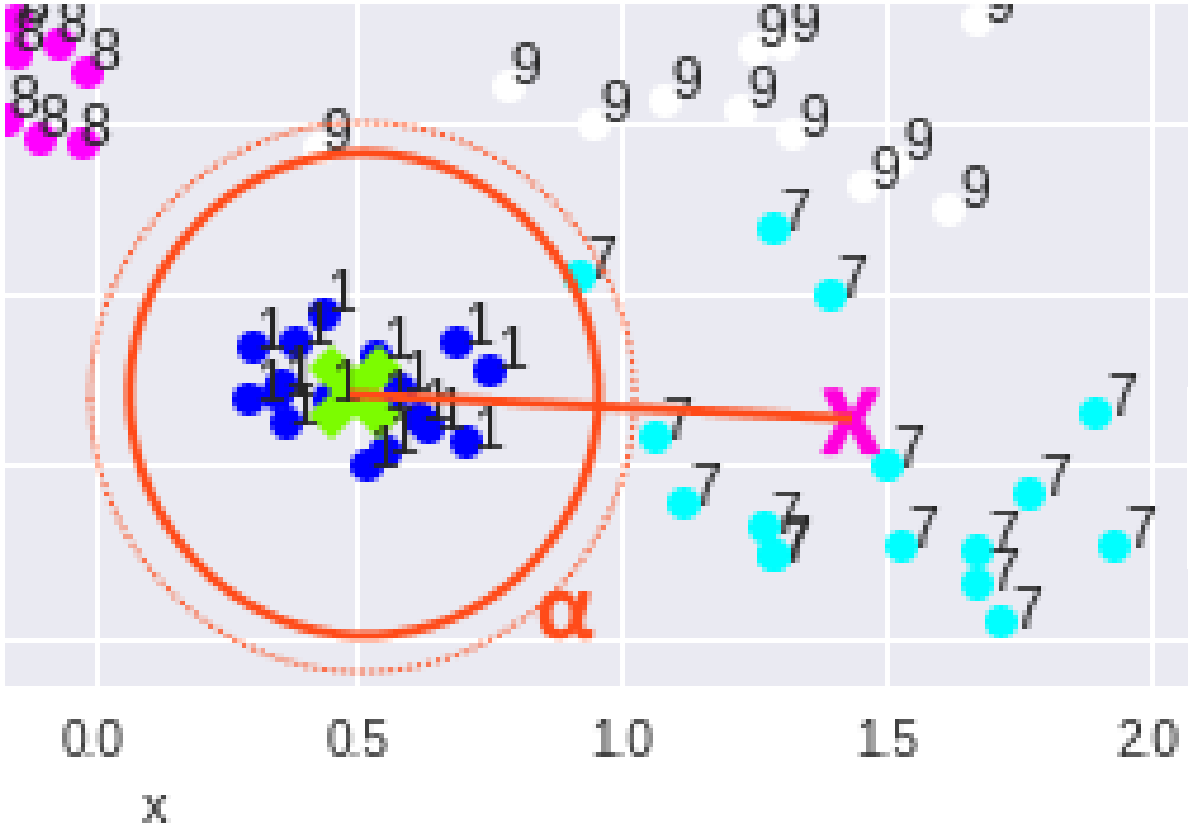
Its center of gravity R, then from the

Closest other center of Gravity R'

$$\frac{1}{N}\sum_{n-1}^{N}\|R-x_i\|_2^2+\alpha\leq\frac{1}{2}\left\|R-\bar{R}\right\|_2^2$$

Alpha is the margin

NEW LOSS FUNCTION

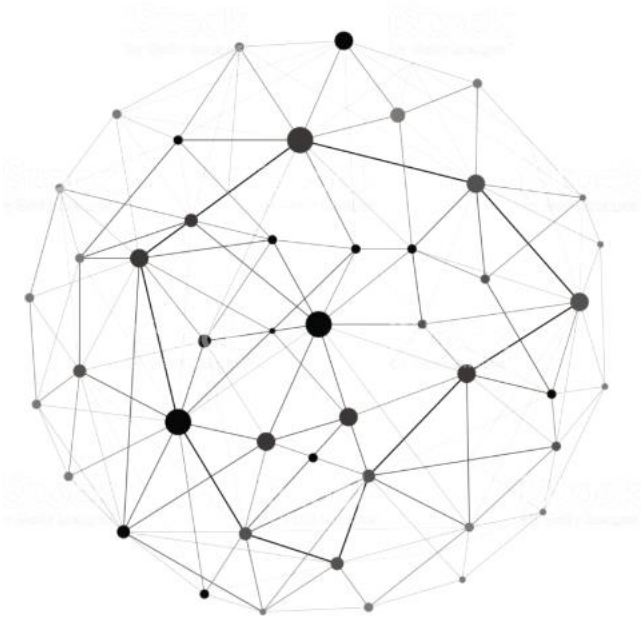


$$\frac{1}{N}\sum_{n=1}^{N}\|R-x_i\|_2^2+\alpha\leq\frac{1}{2}\left\|R-\bar{R}\right\|_2^2$$

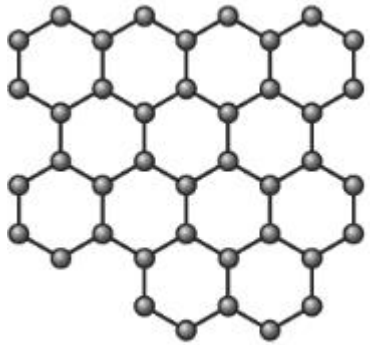
$$\frac{1}{N}\sum_{n=1}^{N}\|R-x_i\|_2^2-\frac{1}{2}\left\|R-\bar{R}\right\|_2^2+\alpha\leq 0$$

$$L(x_i,R,\bar{R})=max(\frac{1}{N}\sum_{n=1}^{N}\|R-x_i\|_2^2-\frac{1}{2}\left\|R-\bar{R}\right\|_2^2+\alpha,0)$$

DISTANCE OF CENTER FACTOR



Add Factor in order to get equal distance of centers of gravity from each other



$$\alpha_2 \left\| \delta_{ij} - c \right\|_2^2$$

$$L(x_i, R, \bar{R}) = max(\frac{1}{N} \sum_{n=1}^{N} \left\| R - x_i \right\|_2^2 - \frac{1}{2} \left\| R - \bar{R} \right\|_2^2 + \alpha + \alpha_2 \left\| \delta_{ij} - c \right\|_2^2, 0)$$