

Exponential triplet loss

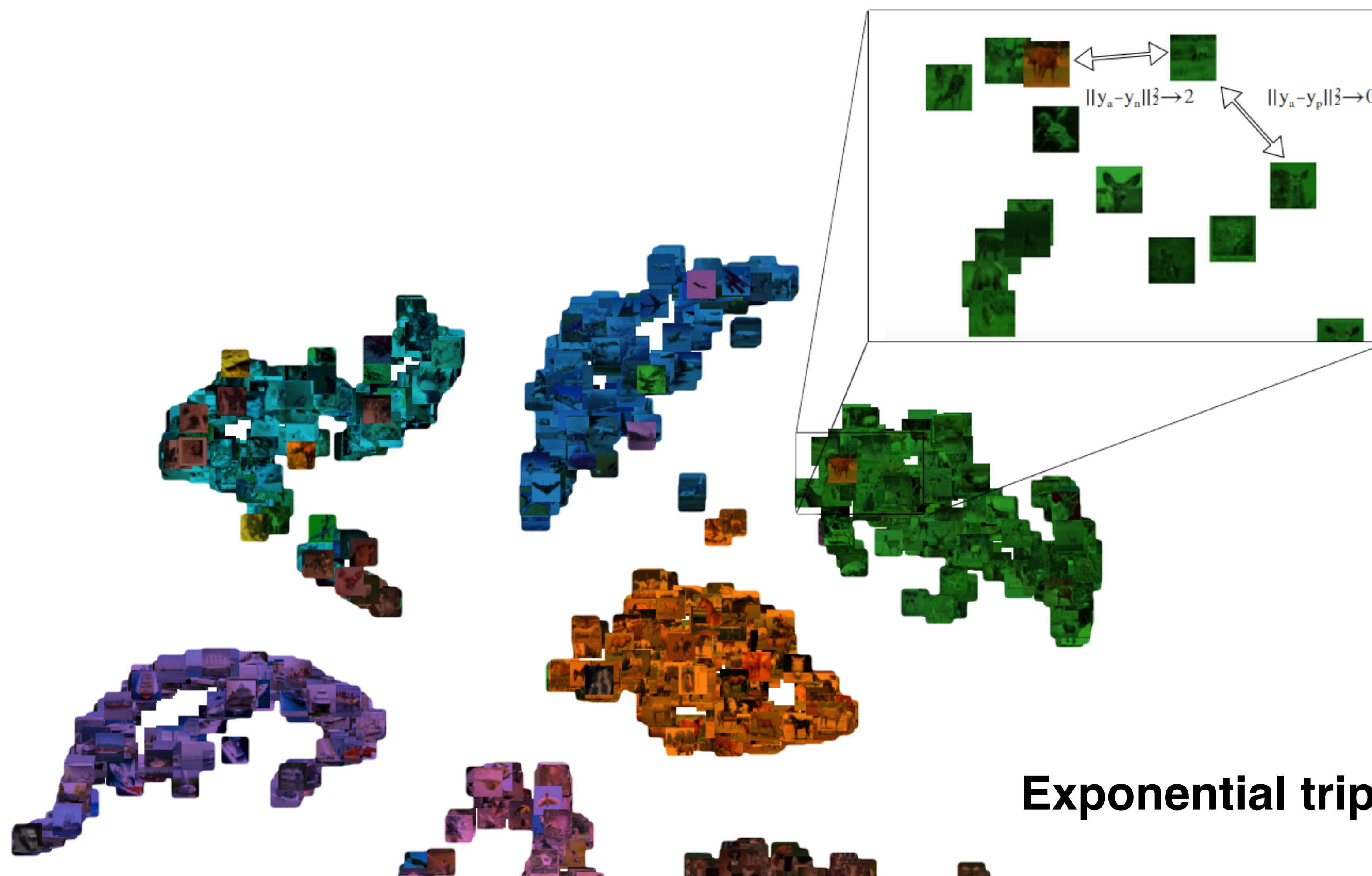
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LATIVIA**

**VALTERS VECINS, RTU, EU,
LATIVIA**

ICCDA 2020

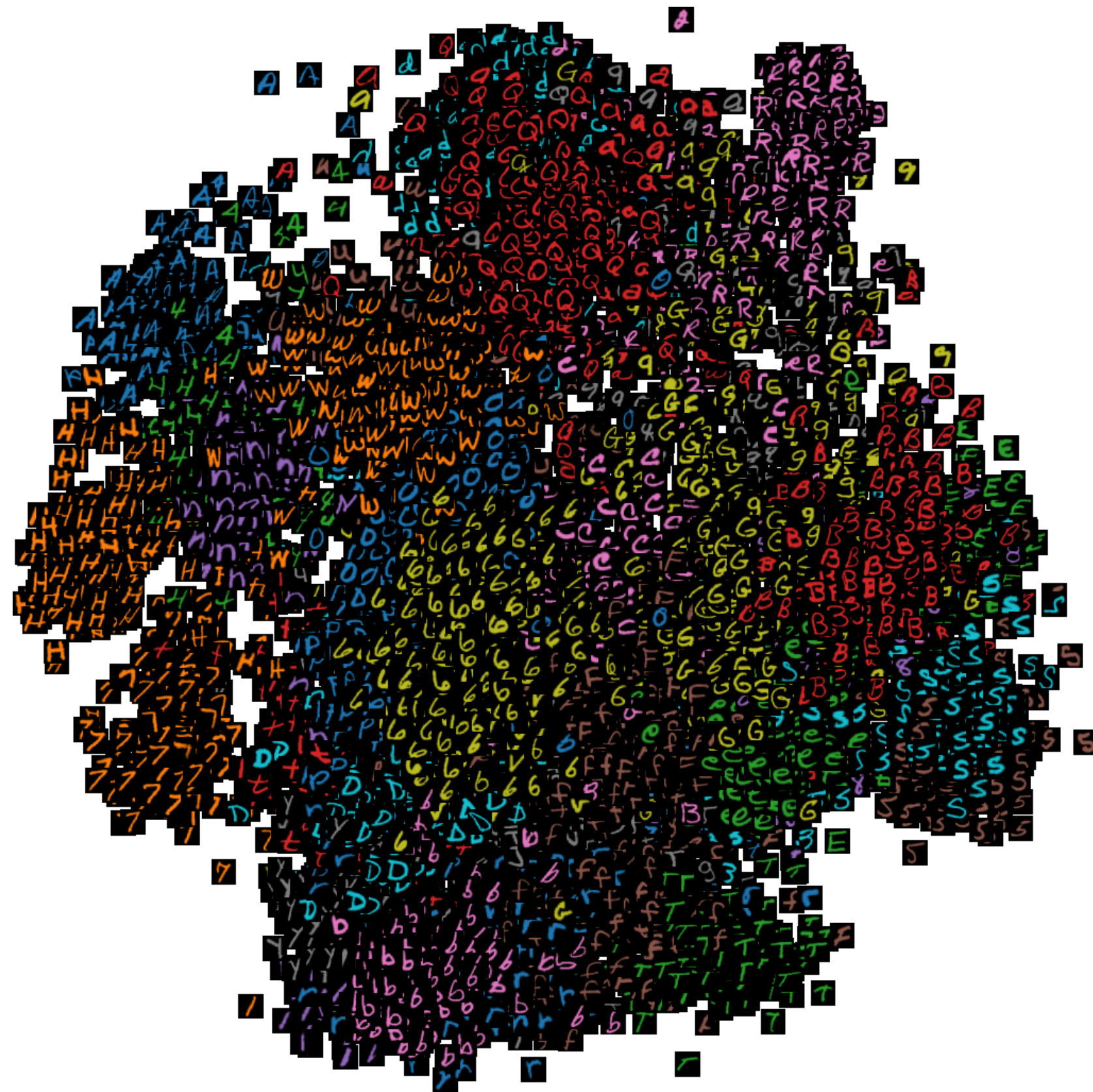
REPRESENTATION LEARNING



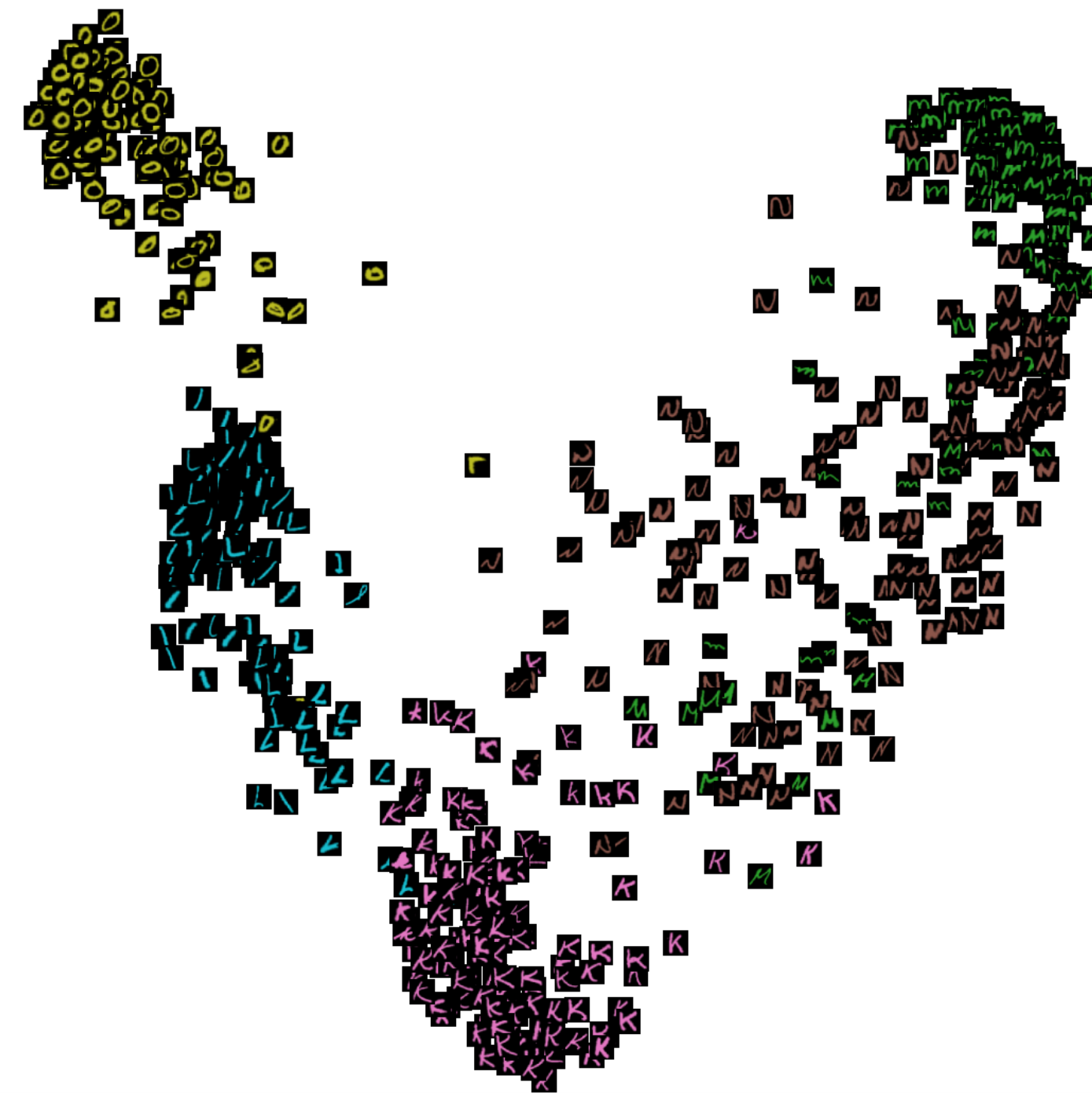
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ZERO-SHOT LEARNING

Training

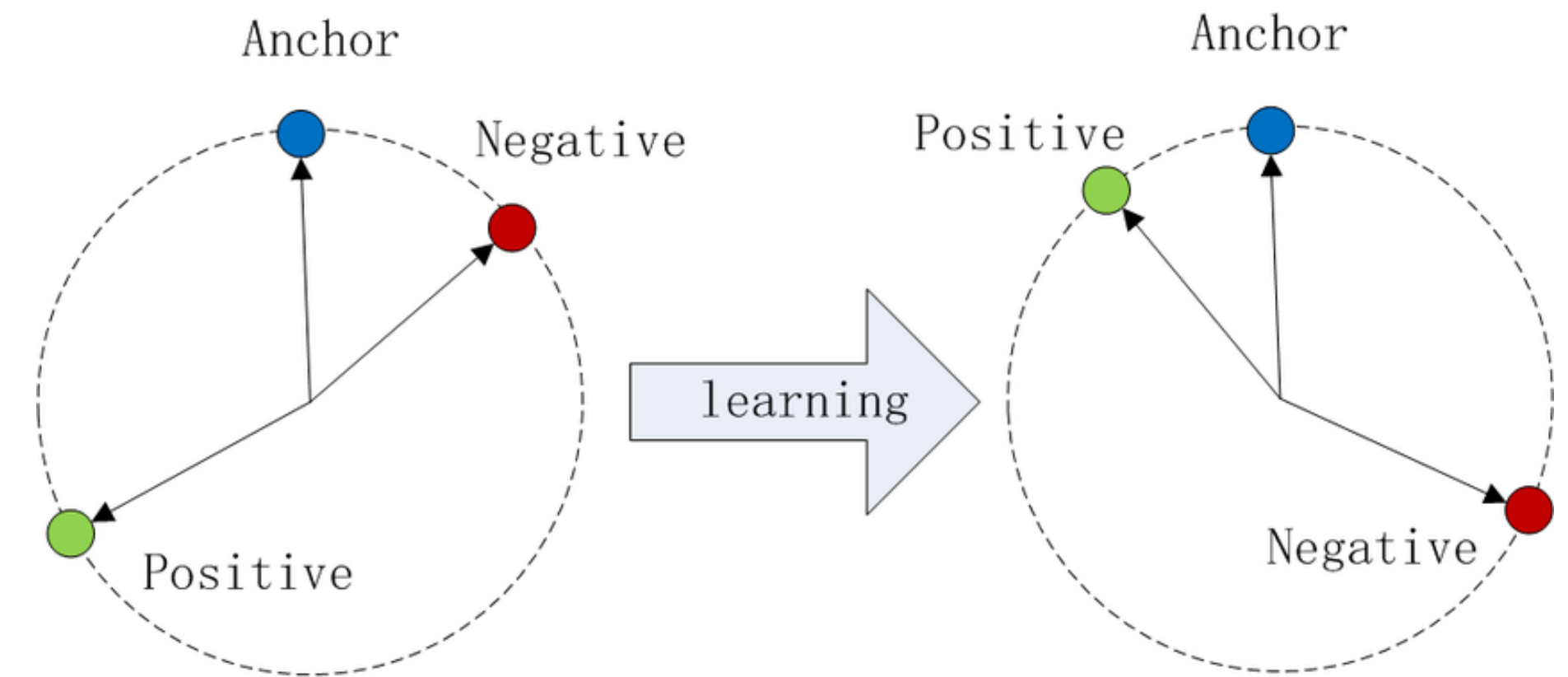
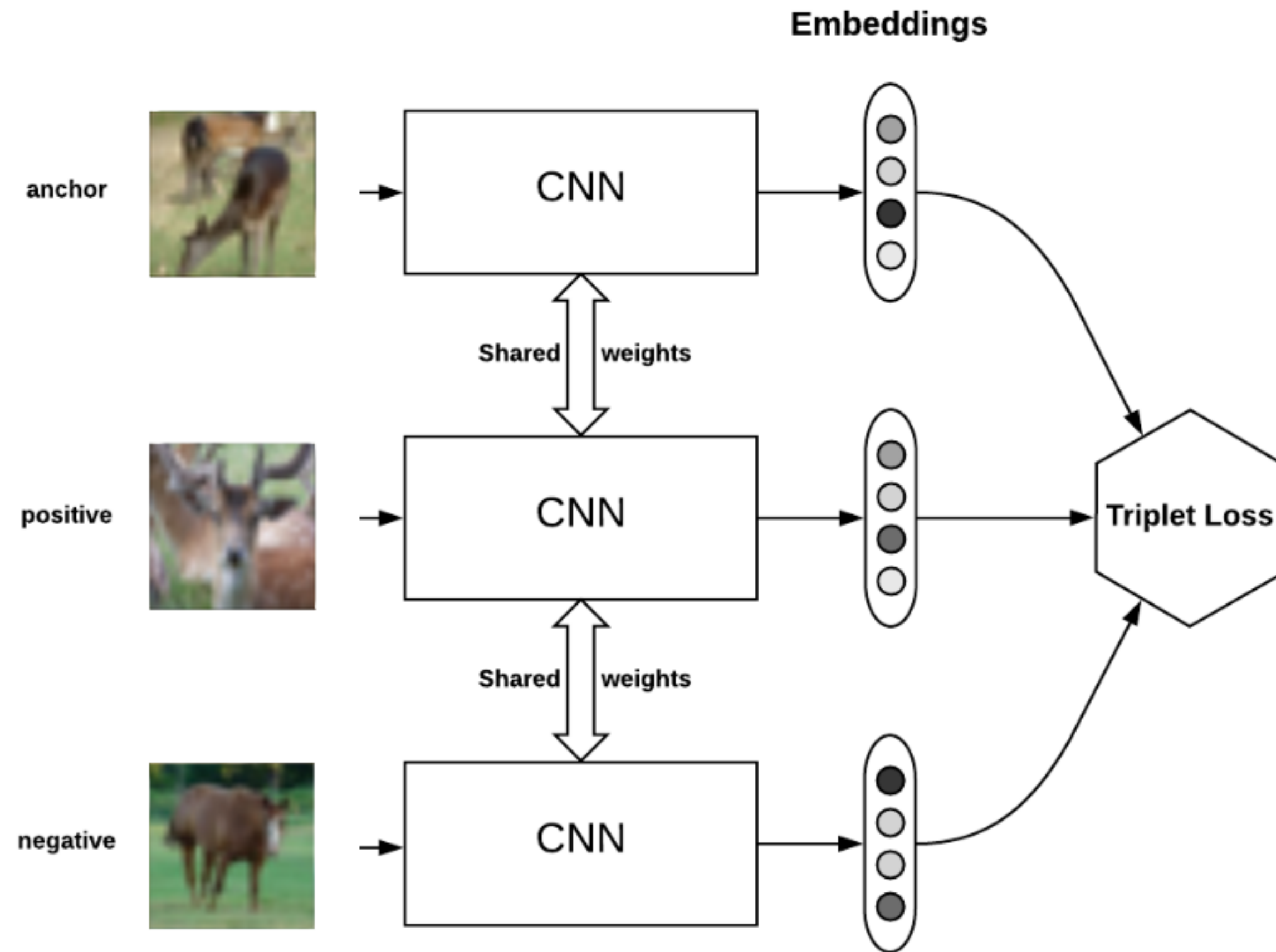


Inference



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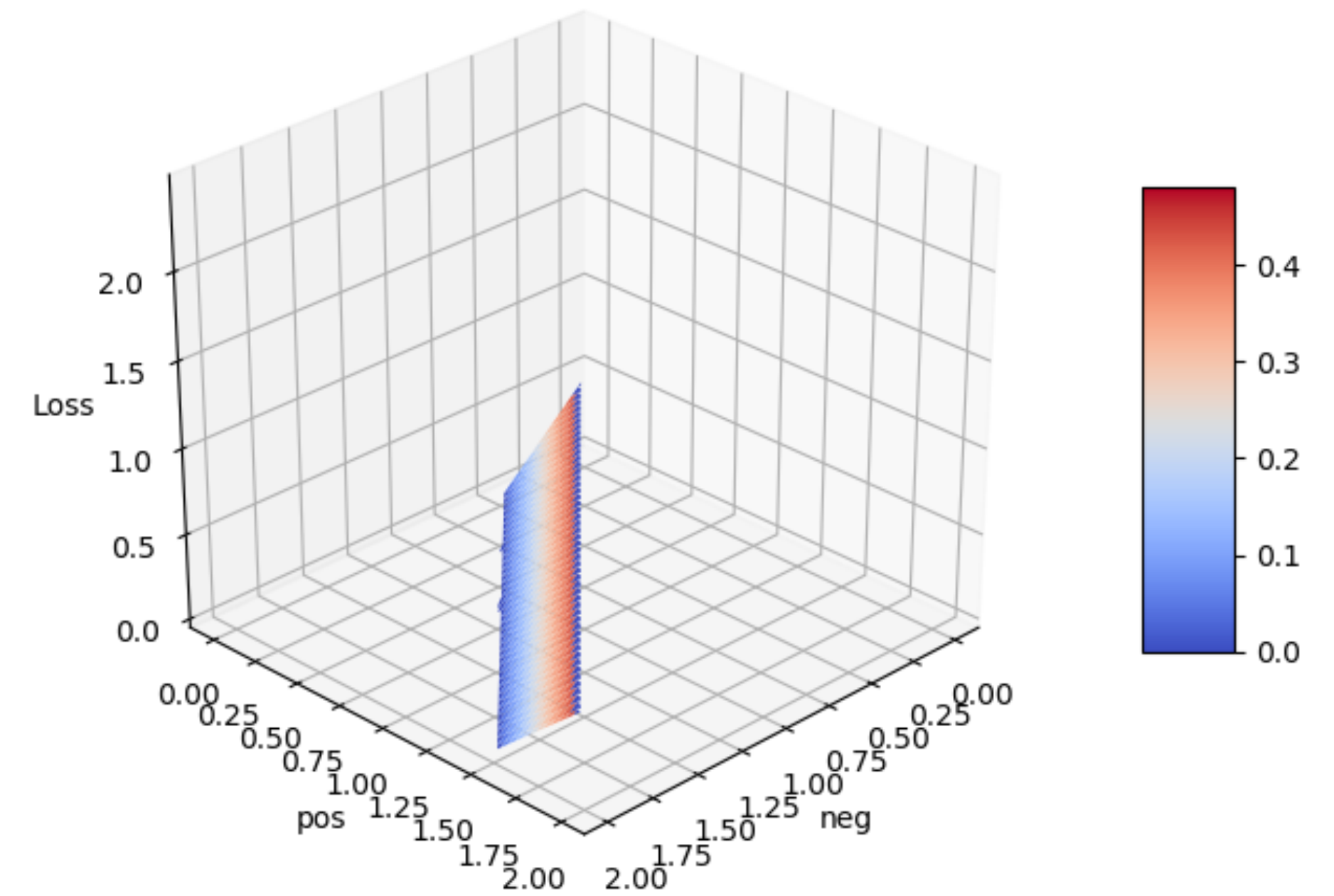
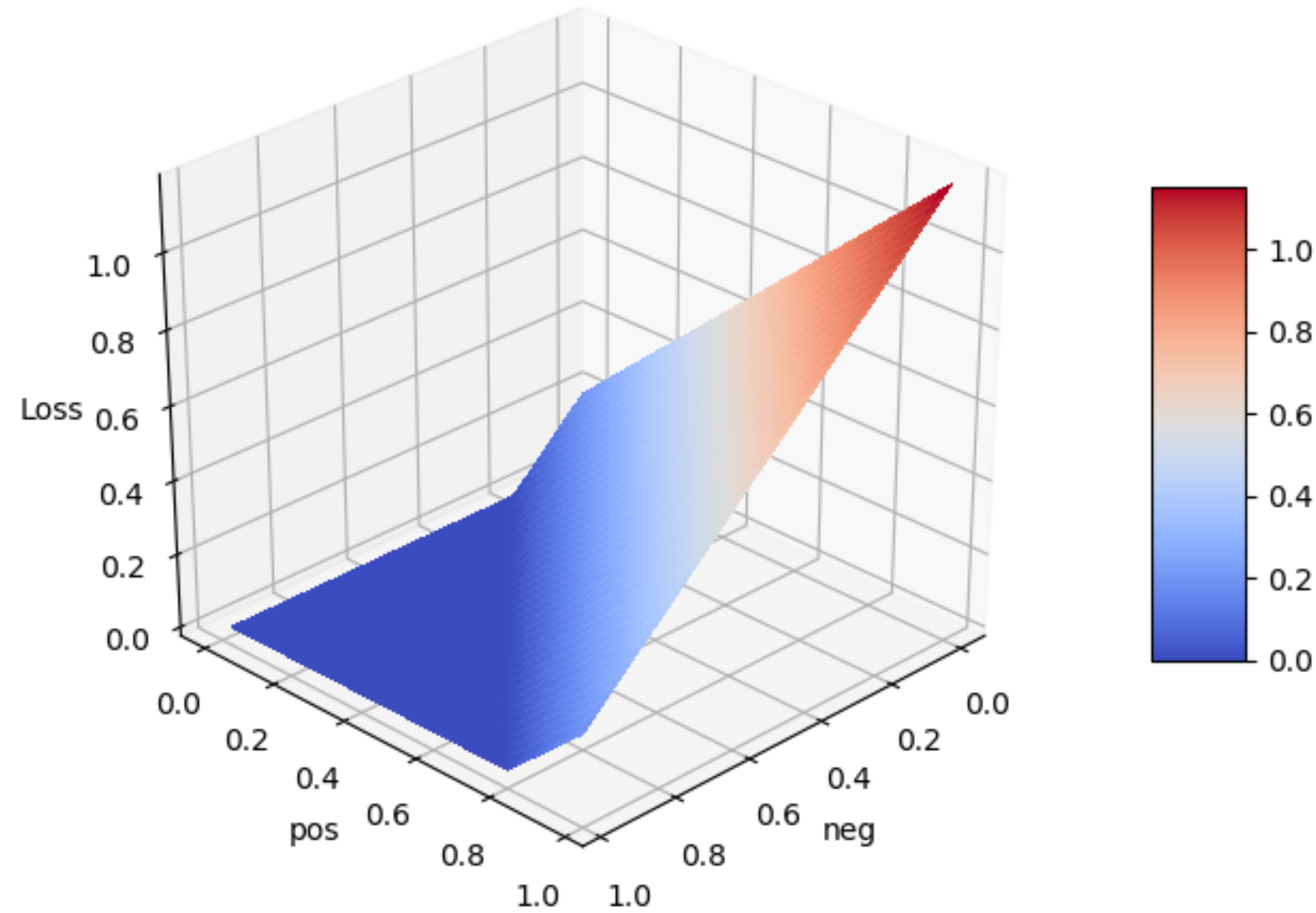
TRIPLER LOSS MODEL



TRIPLER LOSS - PROBLEM

$$\mathcal{L}_{std} = \max(\|y_a - y_p\|_2^2 - \|y_a - y_n\|_2^2 + \alpha, 0)$$

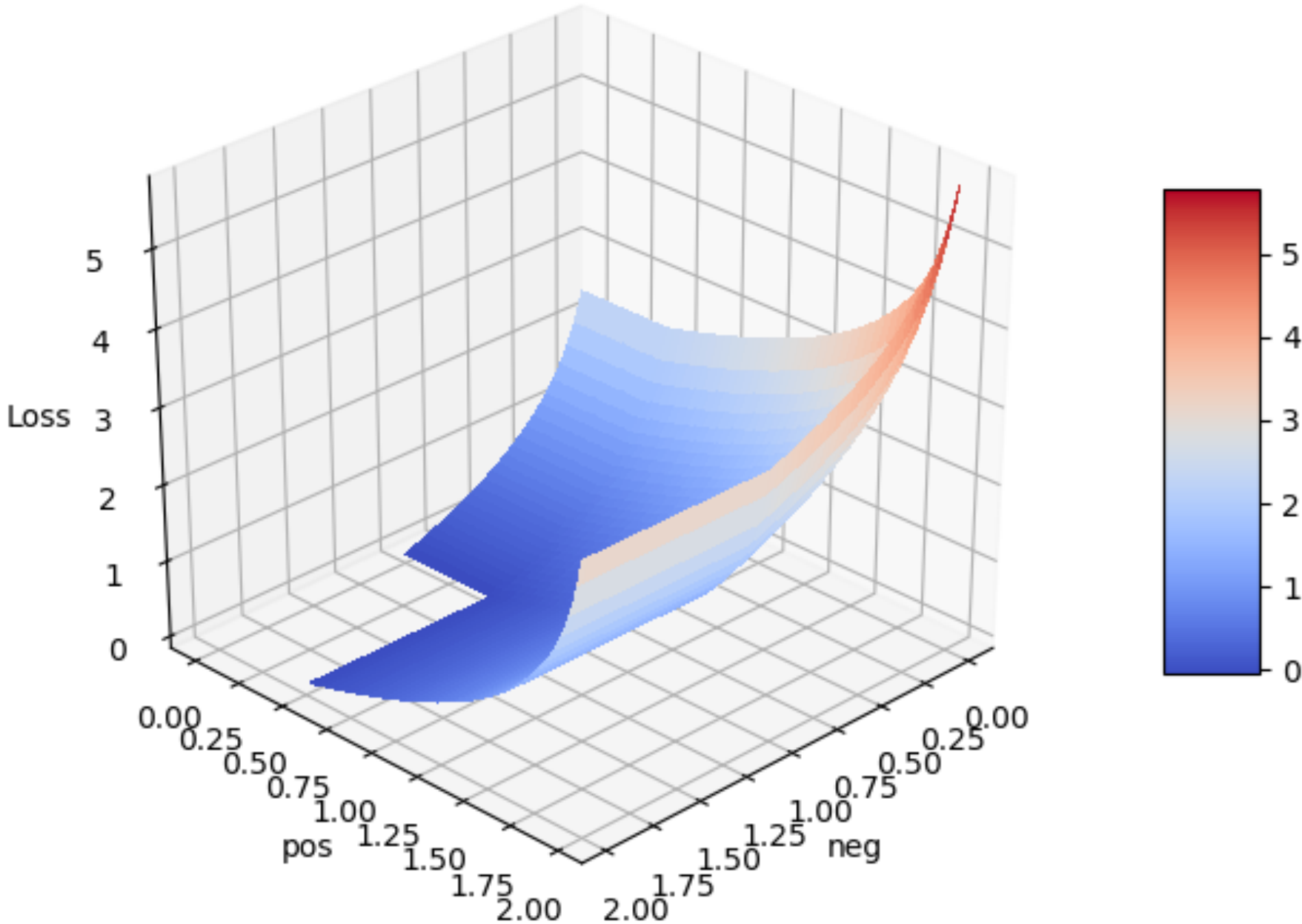
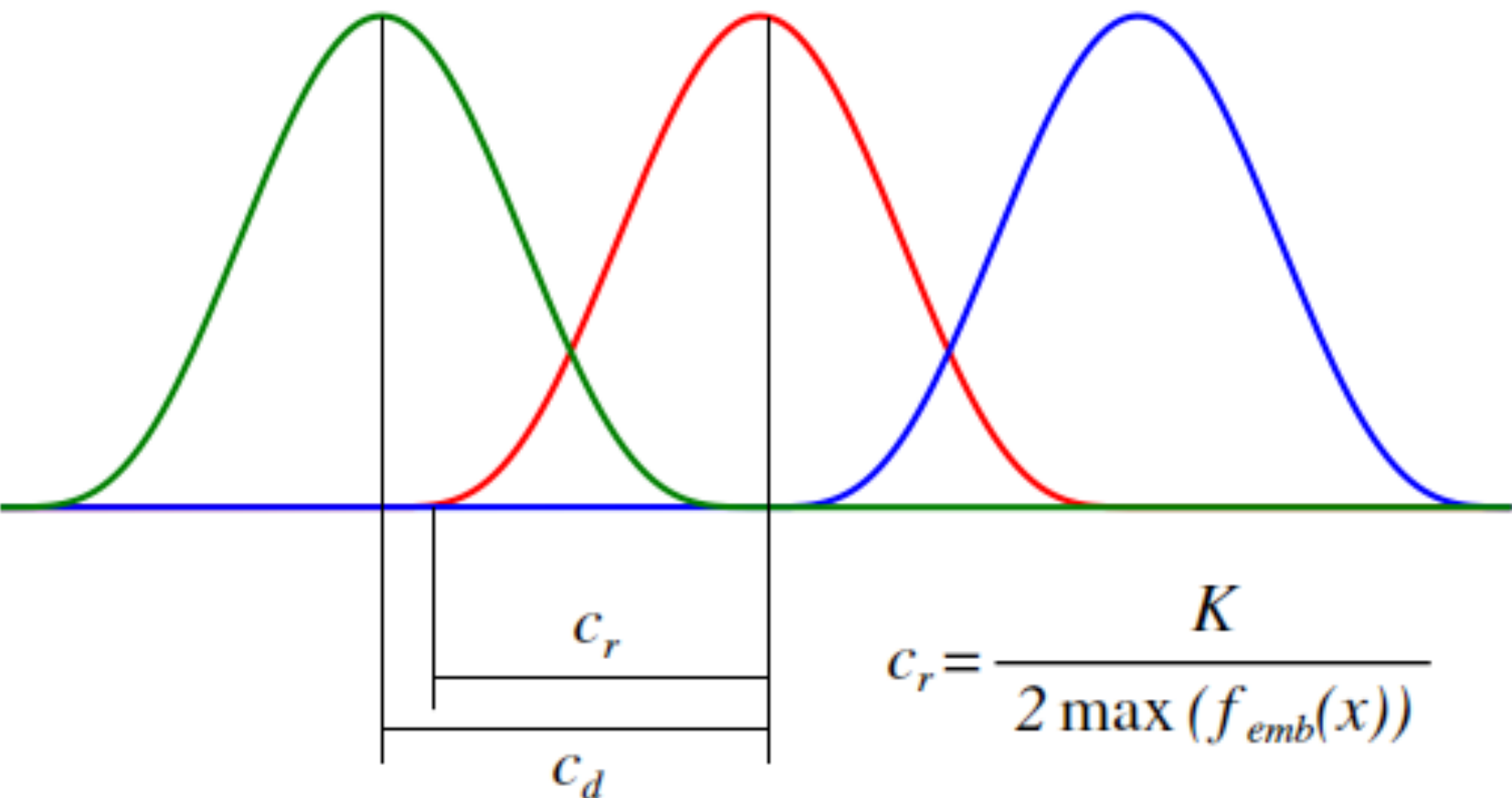
- (1) "Hard constraint" $\|y_a - y_p\|_2^2 + \alpha < \|y_a - y_n\|_2^2$
- (2) "Semi-hard constraint" $\|y_a - y_n\|_2^2 < \|y_a - y_p\|_2^2$



EXPONENTIAL TRIPLET LOSS

$$\mathcal{L}_{exp} = -C_{pos} \cdot \log\left(1.0 - \frac{|emb_p - c_n|_+}{1 - c_n} + \epsilon\right) - C_{neg} \cdot \log\left(1.0 - \frac{|0.5 - emb_n|_+}{0.5} + \epsilon\right)$$

$$emb_p = \frac{y_p}{\max(f_{emb}(x))} \quad emb_n = \frac{y_n}{\max(f_{emb}(x))}$$



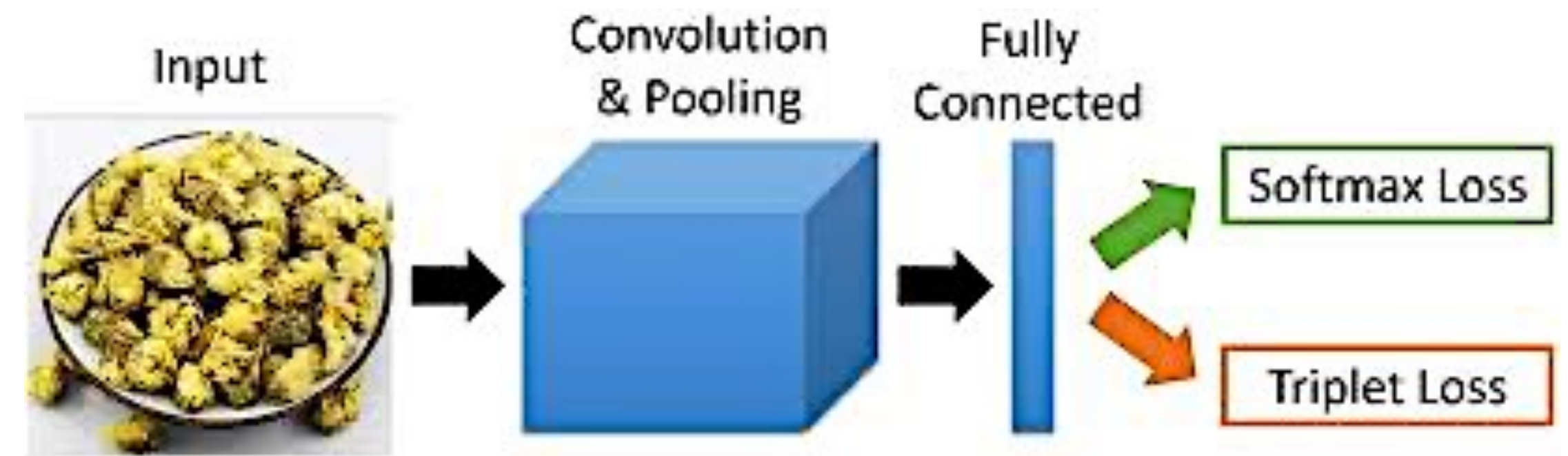
COMPOSITE EXPONENTIAL TRIPLET LOSS

$$\mathcal{L}_{class} = - \sum_{i=1}^M y_i \log \frac{e^{W_i^T s \|f(x_i)\|_2^2 + b_i}}{\sum_{j=1}^C e^{W_j^T s \|f(x_i)\|_2^2 + b_j}}$$

$$\mathcal{L}_{center'} = \sum_{i=1}^M \|x_i - c_{y_i}\|_2^2$$

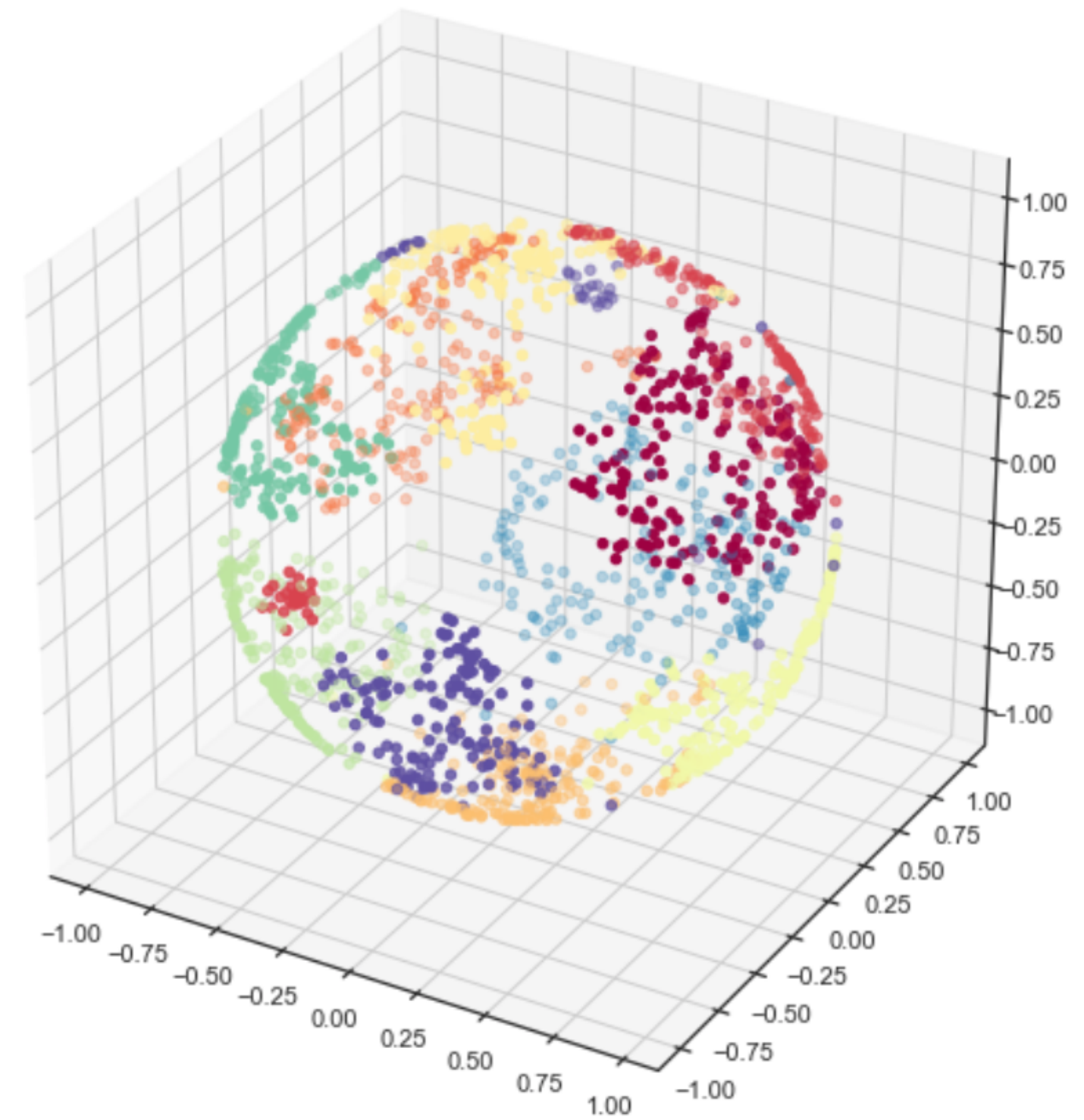
$$\mathcal{L}_{center} = \sum_{i=1}^M \left| \|x_i - c_{y_i}\|_2^2 - \frac{c_d}{2} \right|_+$$

$$\mathcal{L} = \mathcal{L}_{exp} + C_{center} \mathcal{L}_{center} + C_{class} \mathcal{L}_{class}$$



L2 EMBEDDING SPACE

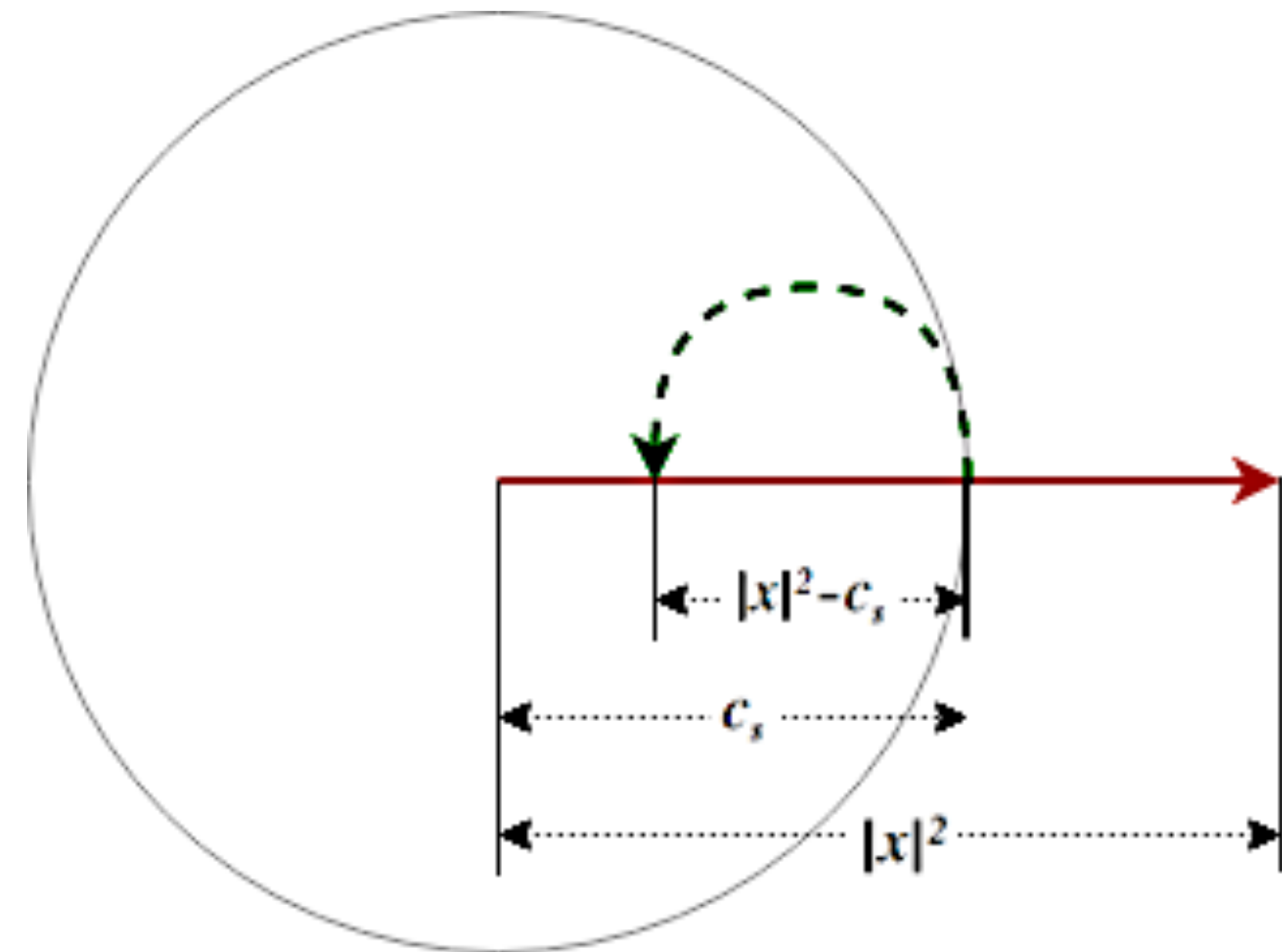
$$f_{emb}(x) = c_s \frac{x}{|x|^2}$$



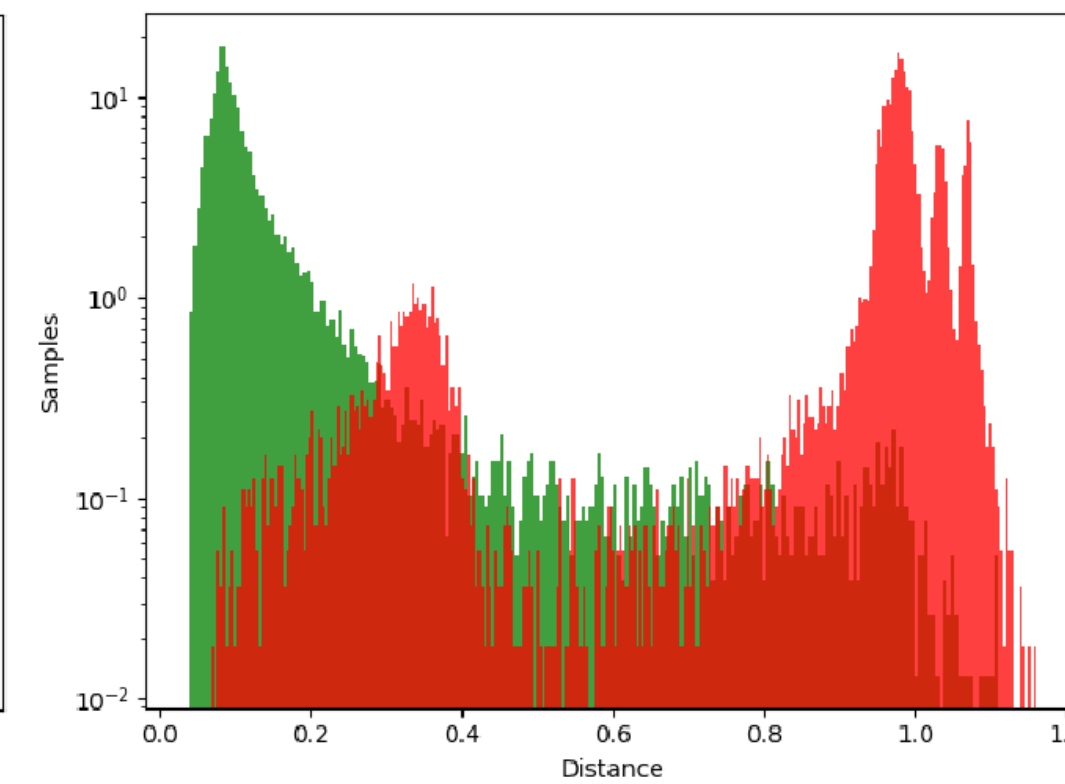
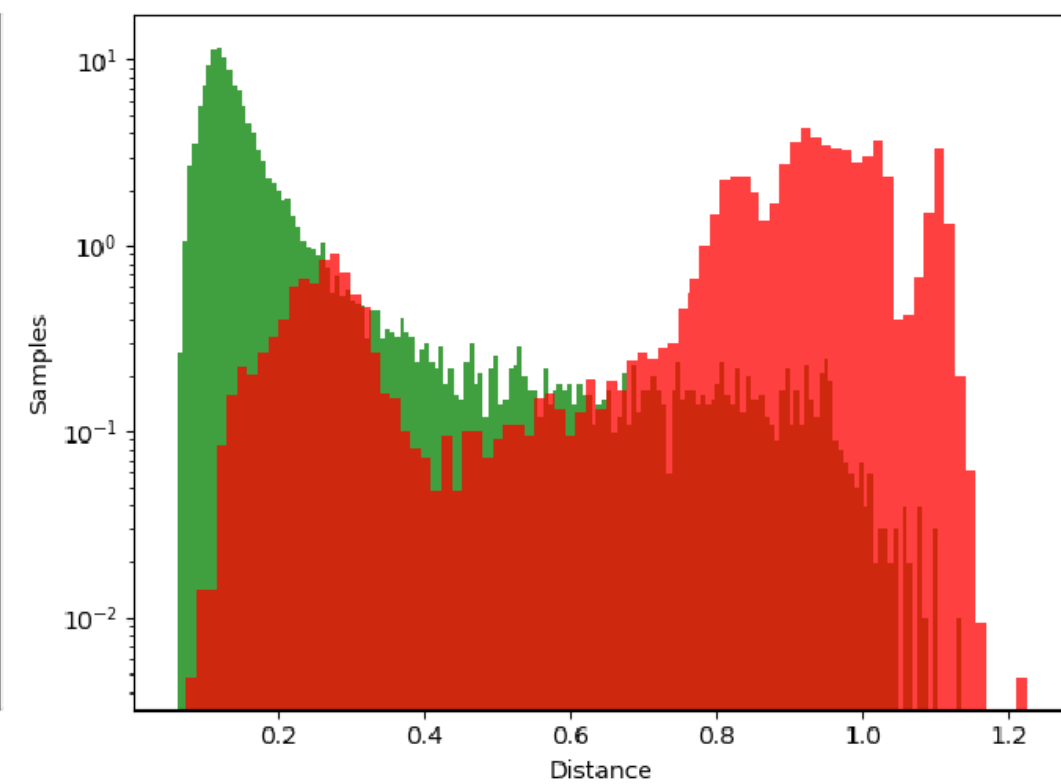
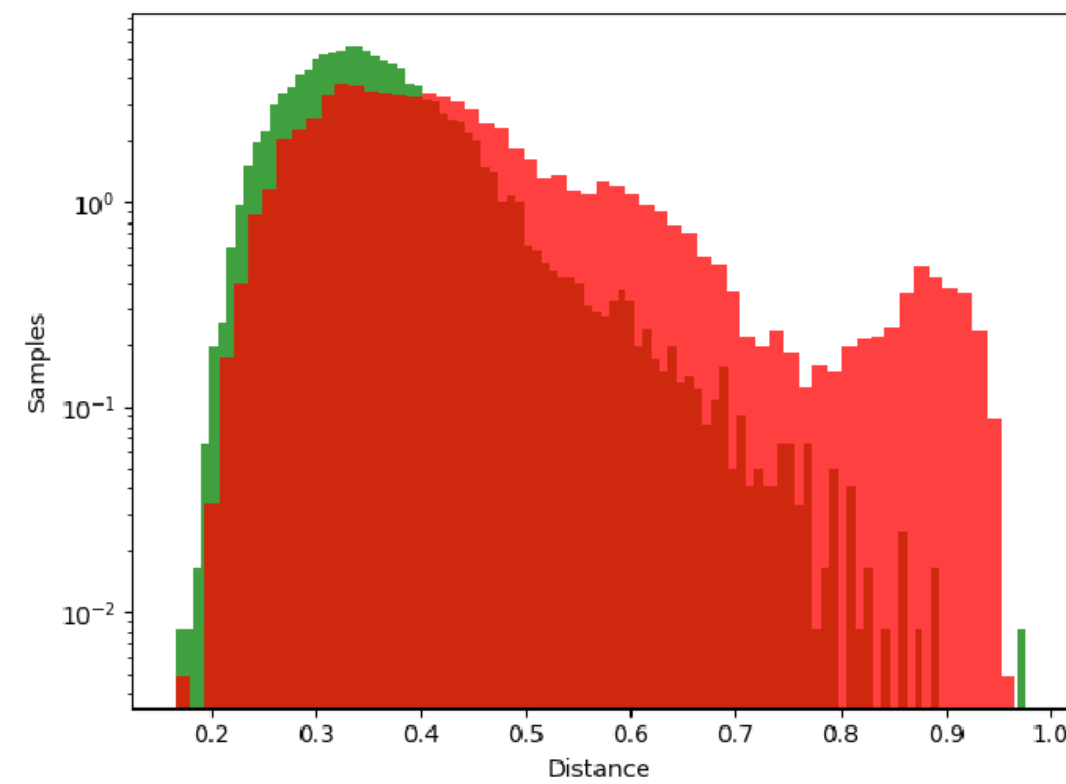
UNIT-BOUNCE EMBEDDING SPACE

$$f'_{emb}(x) = \begin{cases} f_{bounce}(x), & \text{if } |x|^2 \geq 1 \\ x, & \text{otherwise} \end{cases}$$

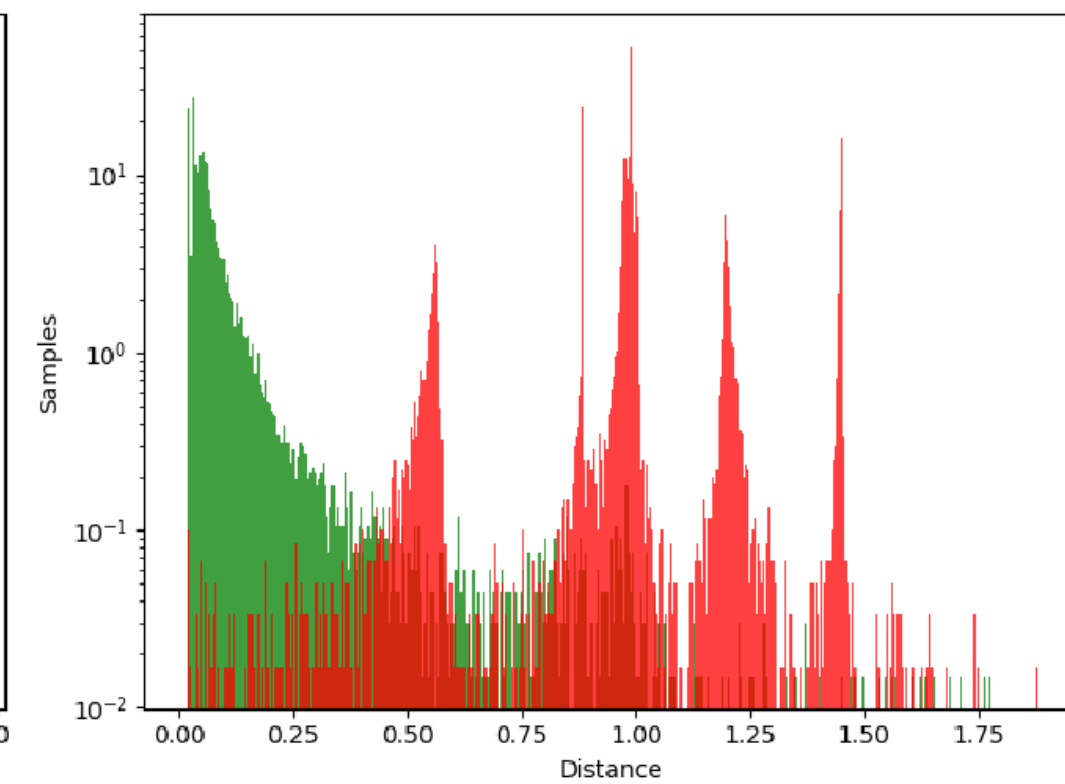
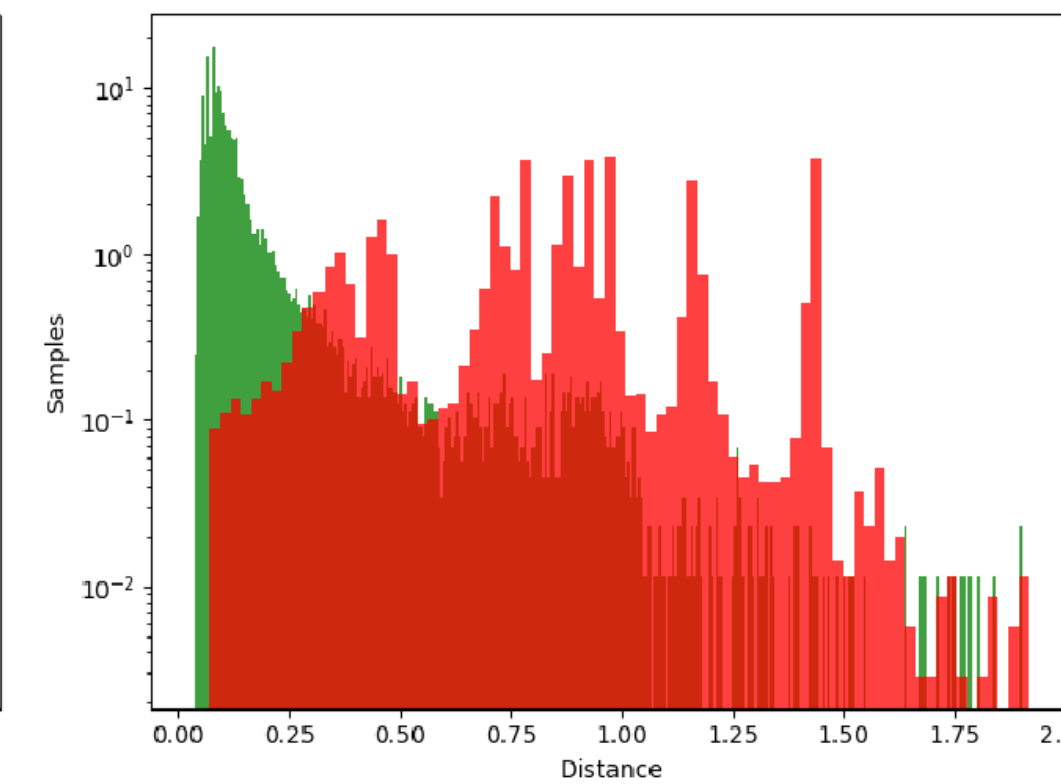
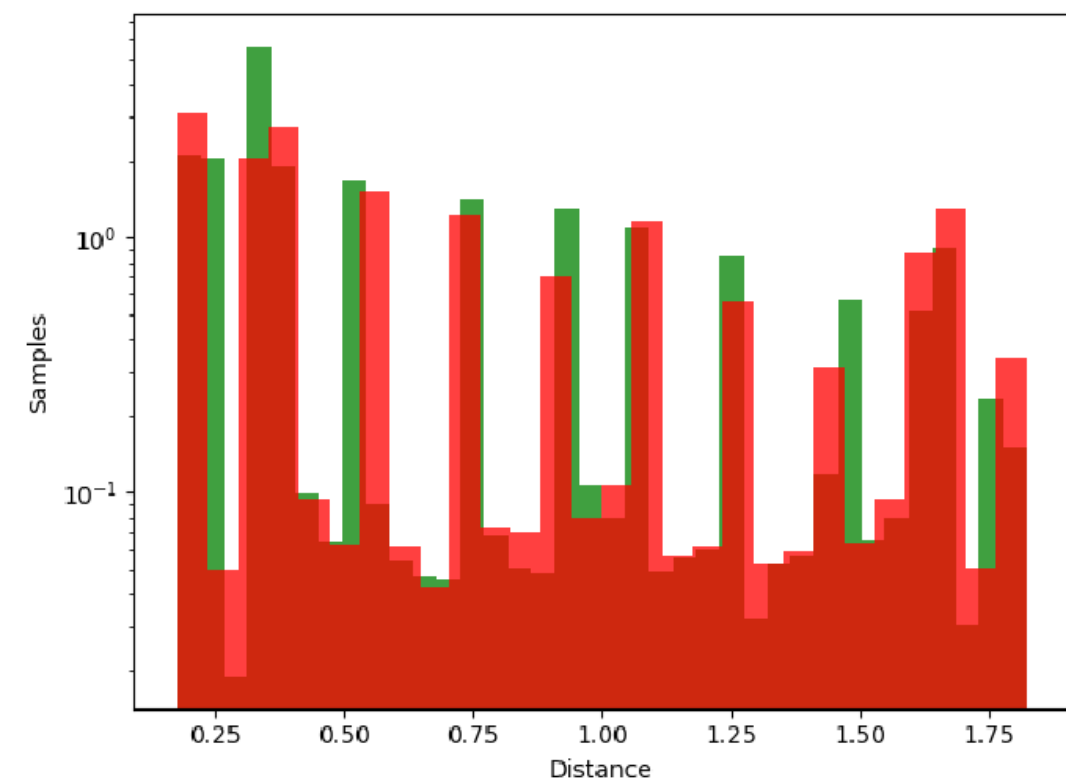
$$f_{bounce}(x) = \begin{cases} |x|^2 - \left\lfloor \frac{|x|^2}{c_s} \right\rfloor - c_s \frac{x}{|x|^2}, & \text{if } \left\lfloor \frac{|x|}{c_s} \right\rfloor \bmod 2 = 0 \\ c_s \frac{x}{|x|^2} - |x|^2 - \left\lfloor \frac{|x|^2}{c_s} \right\rfloor, & \text{otherwise} \end{cases}$$



INITIALIZATION EMBEDDING SPACE



Xavier / Gaussian

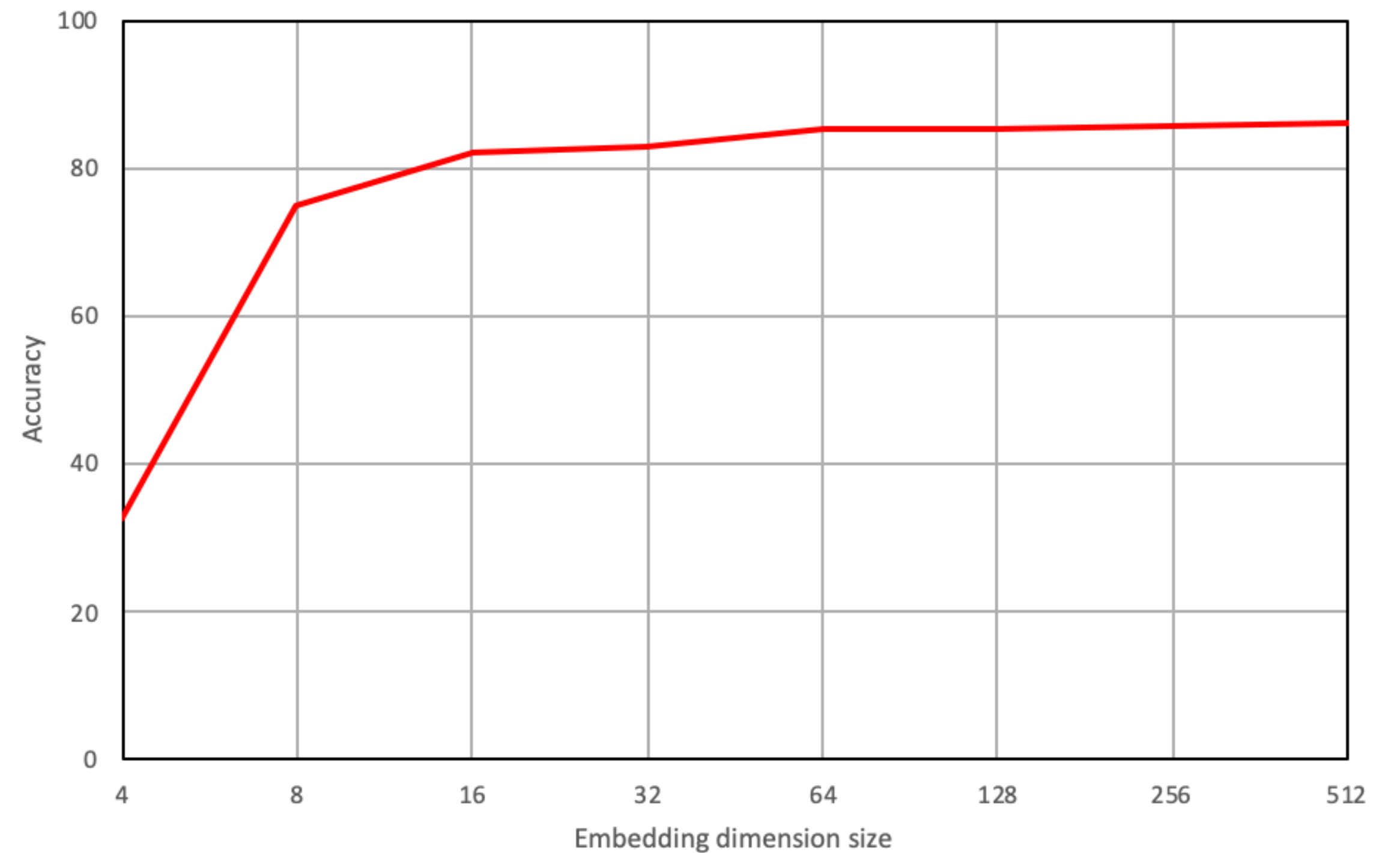
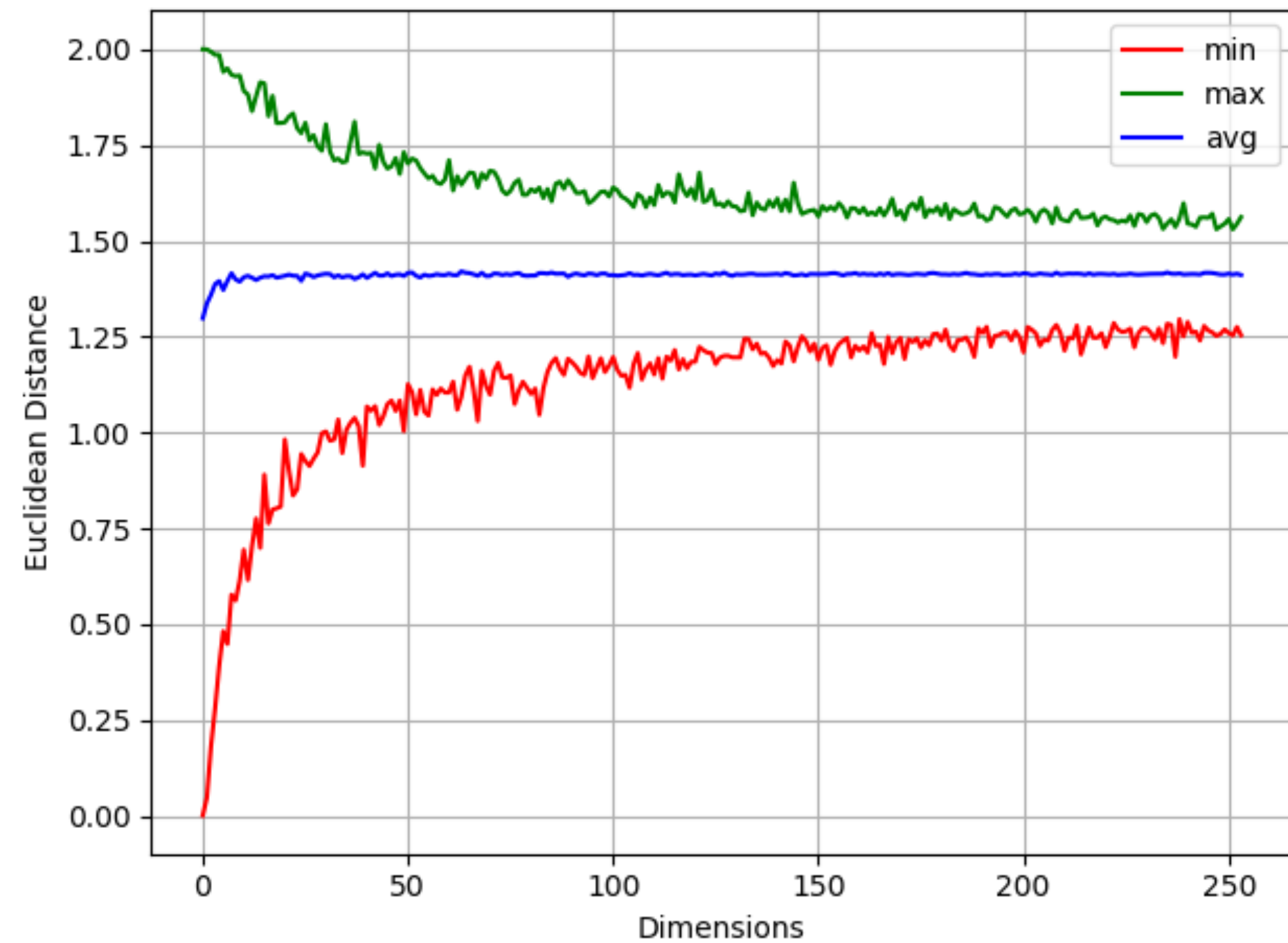


Uniform

Before training

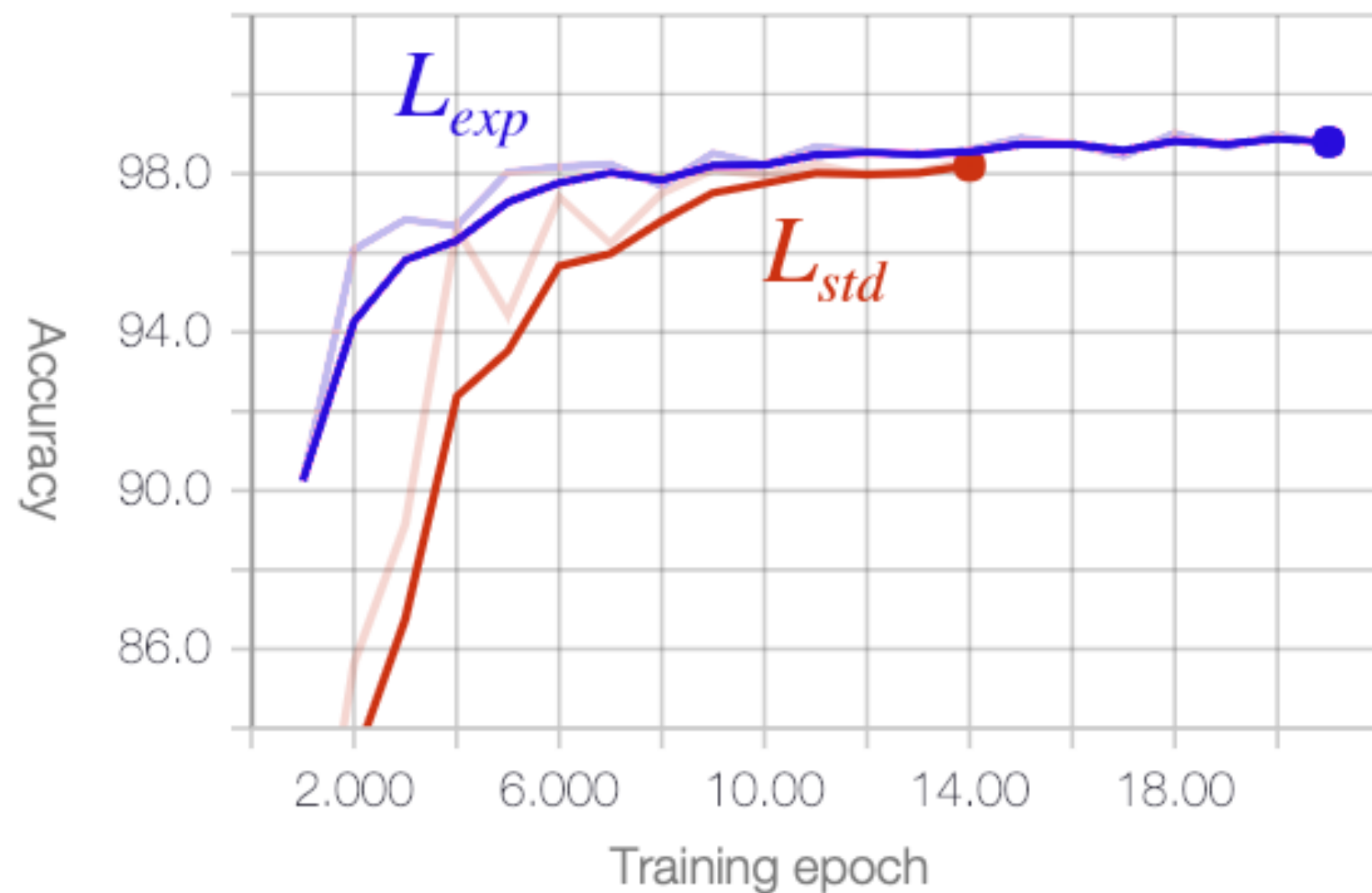
After training

DIMENSIONALITY EMBEDDING SPACE



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QUANTITATIVE RESULTS

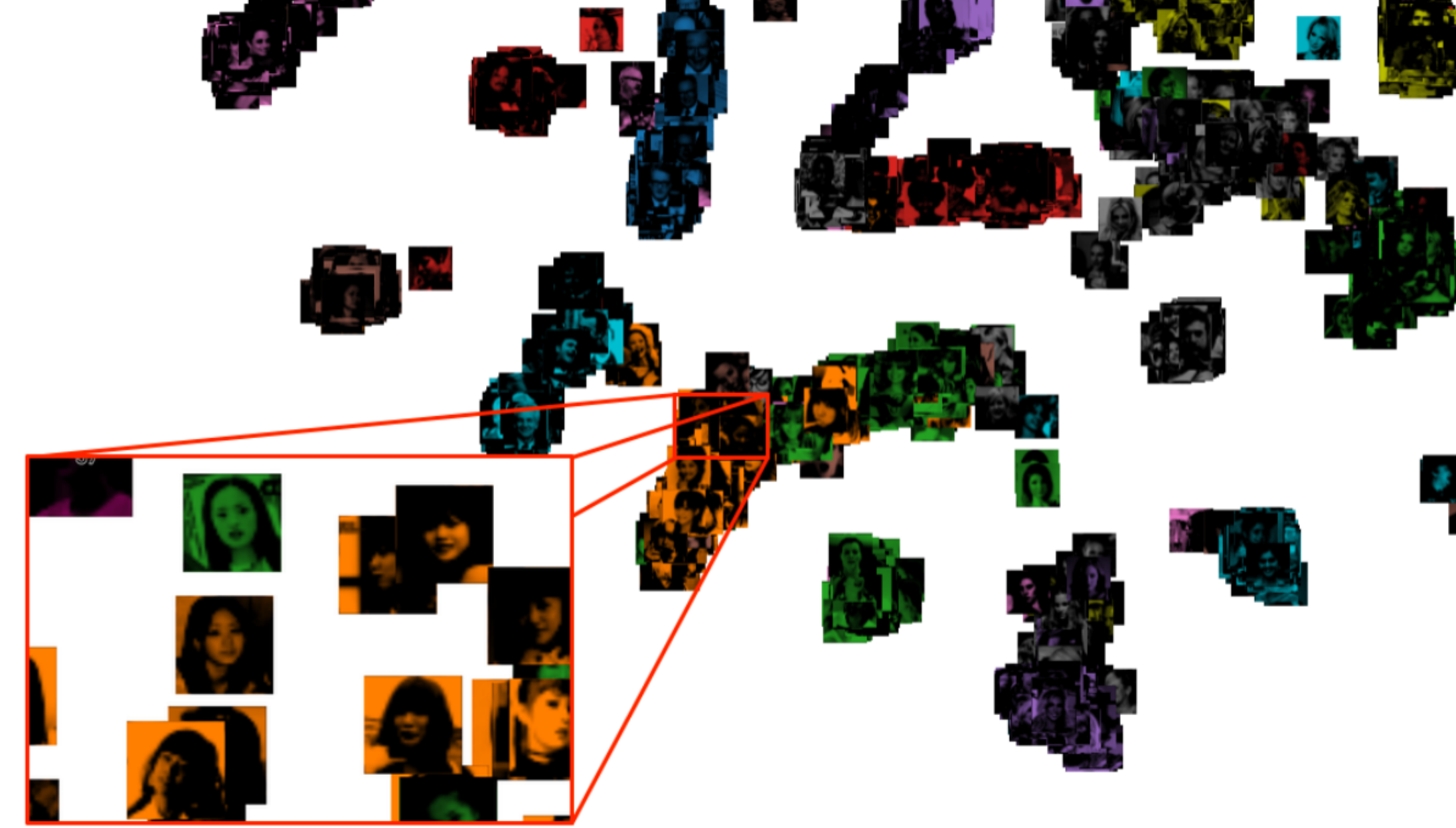
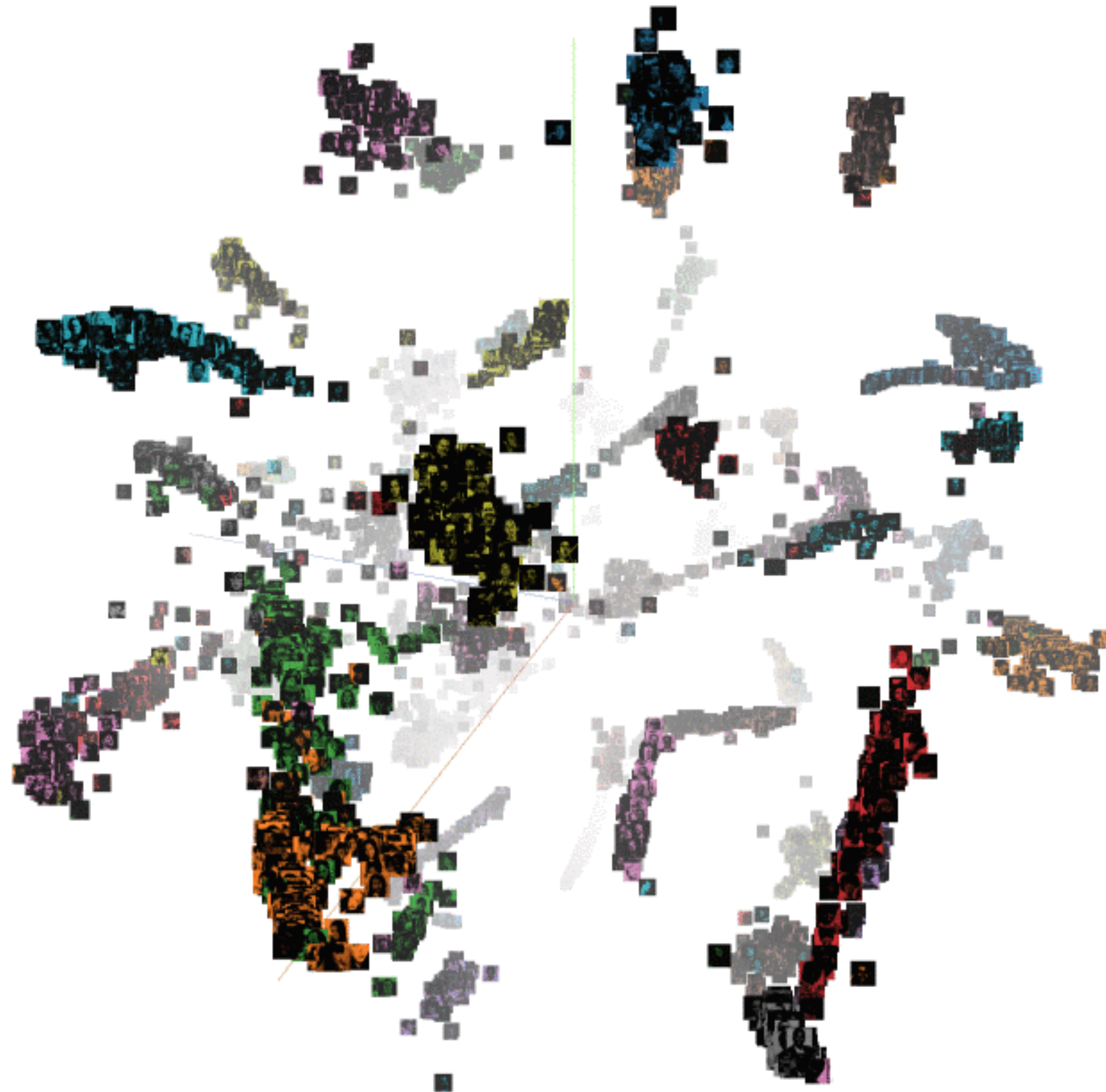


Loss func. / Accuracy %	MNIST	Fashion-MNIST	EMINST	CIFAR10	VGGFace2
L_{std}	99.6	91.4	82.0	56.2	77.4
$L_{std} + L_{class}$	99.6	92.1	85.0	79.8	76.3
$L_{std} + L_{center}$	97.5	71.5	61.7	52.1	76.4
$L_{std} + L_{center} + L_{class}$	97.7	82.0	70.9	62.8	78.6
L_{exp}	99.6	92.7	82.7	85.7	85.0
$L_{exp} + L_{class}$	99.6	93.1	85.2	87.2	84.1
$L_{exp} + L_{center}$	99.6	93.1	85.7	85.3	84.0
$L_{exp} + L_{center} + L_{class}$	99.6	93.1	86.0	87.3	85.7

Source code:

<https://github.com/evaldsurtans/exponential-triplet-loss>

QUALITATIVE RESULTS



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Carl

Sideshow
Bob

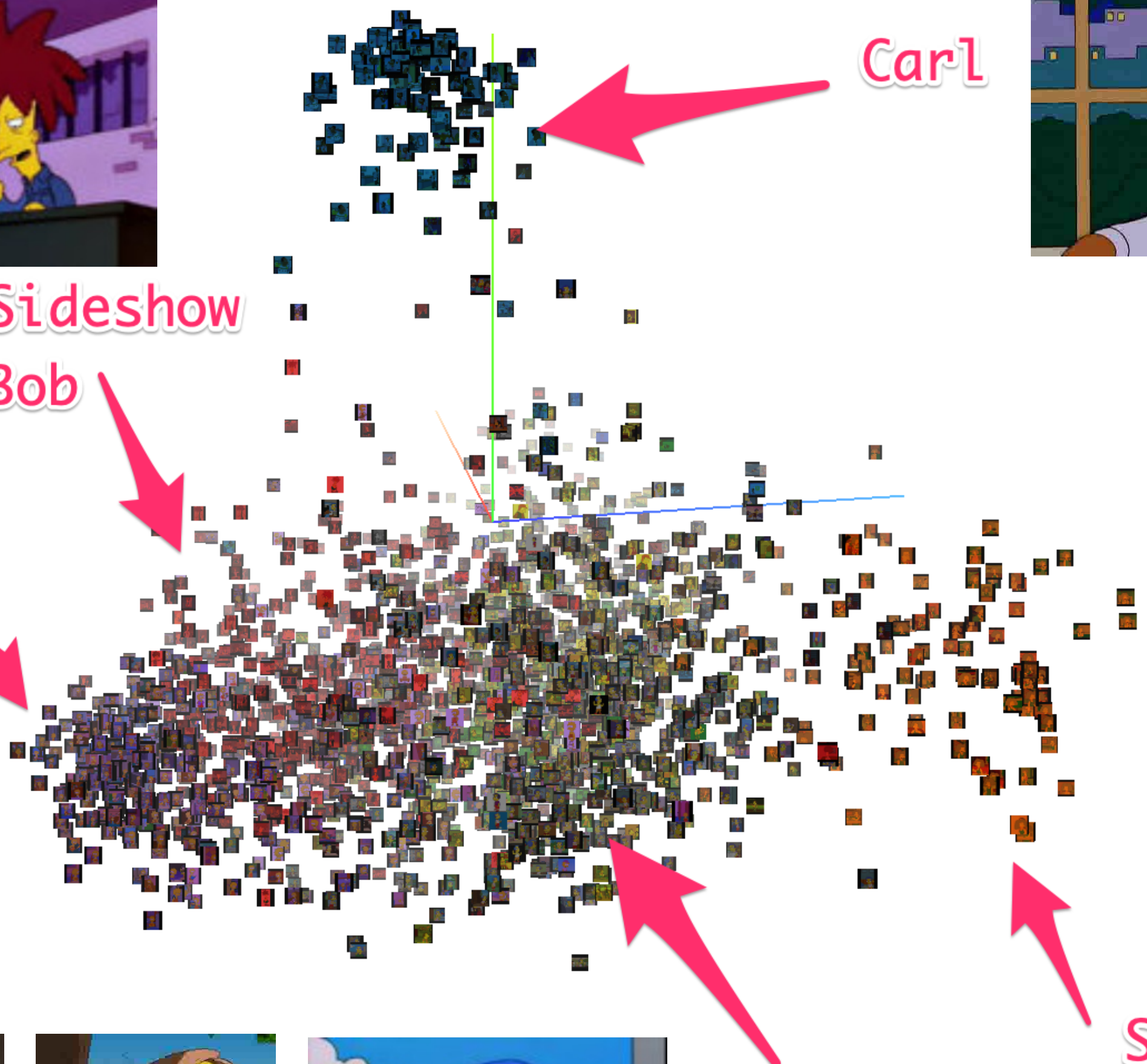
Lisa



Selma



Kids/Boys



THE SIMPSONS

FUTHER RESEARCH

- **Sample mining efficiency**
- **Combing with variational models**
- **Combing with generative models**

APPLICATION



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