One-shot Learning using Triplet Networks with kNN Classifier

Mu Zhou[1,2], Yusuke Tanimura[2,1], Hidemoto Nakada[2,1]

[1]University of Tsukuba
[2]Artificial Intelligence Research Center - National Institute of Advanced Industrial Science and Technology

Content

- **Introduction**
- Related work
- Method
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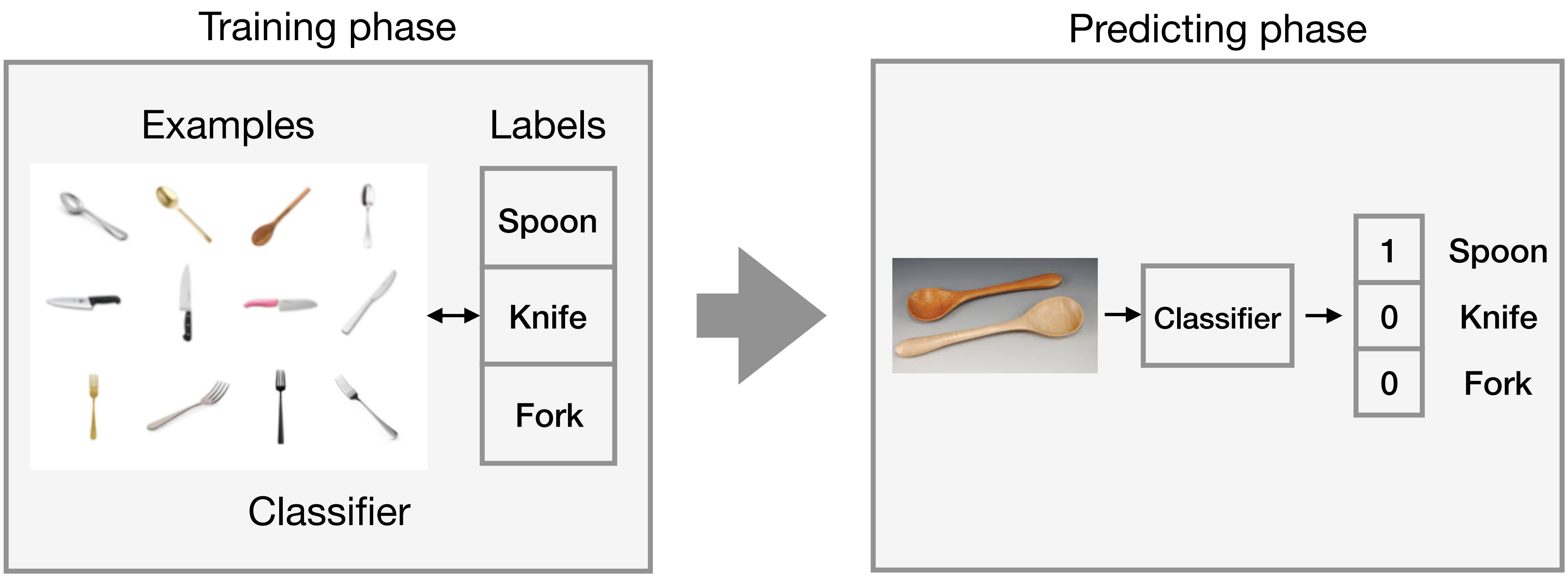
- Results

Introduction

Supervised Learning

- Learn a correspondence between training data and labels.
  - Require a **large labeled dataset** for training.



- Hard to let classifiers learn new concepts from little data.

Introduction

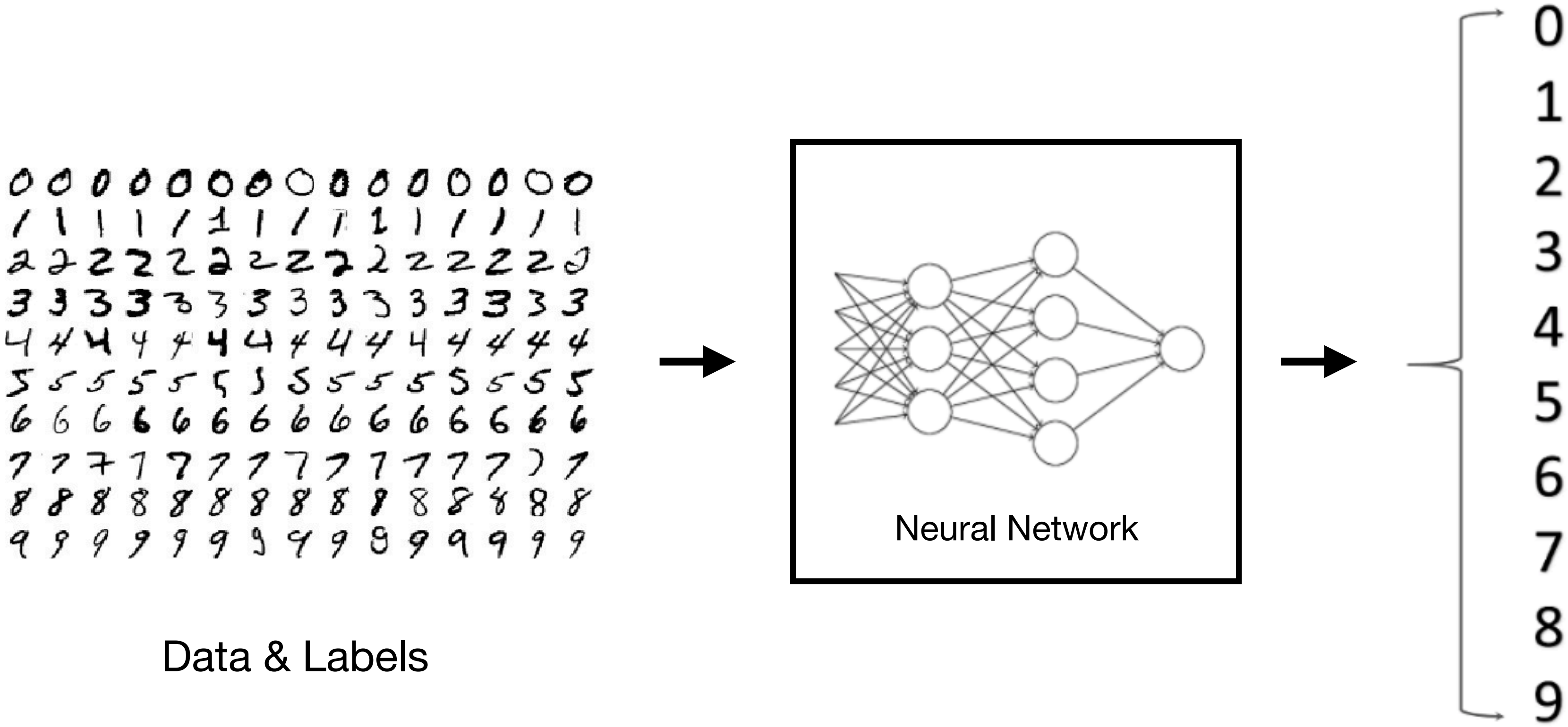
One-shot Learning

- Learn a concept from **one or only a few** training example, contrary to the normal practice of using a large amount of data.

Introduction

Image classification

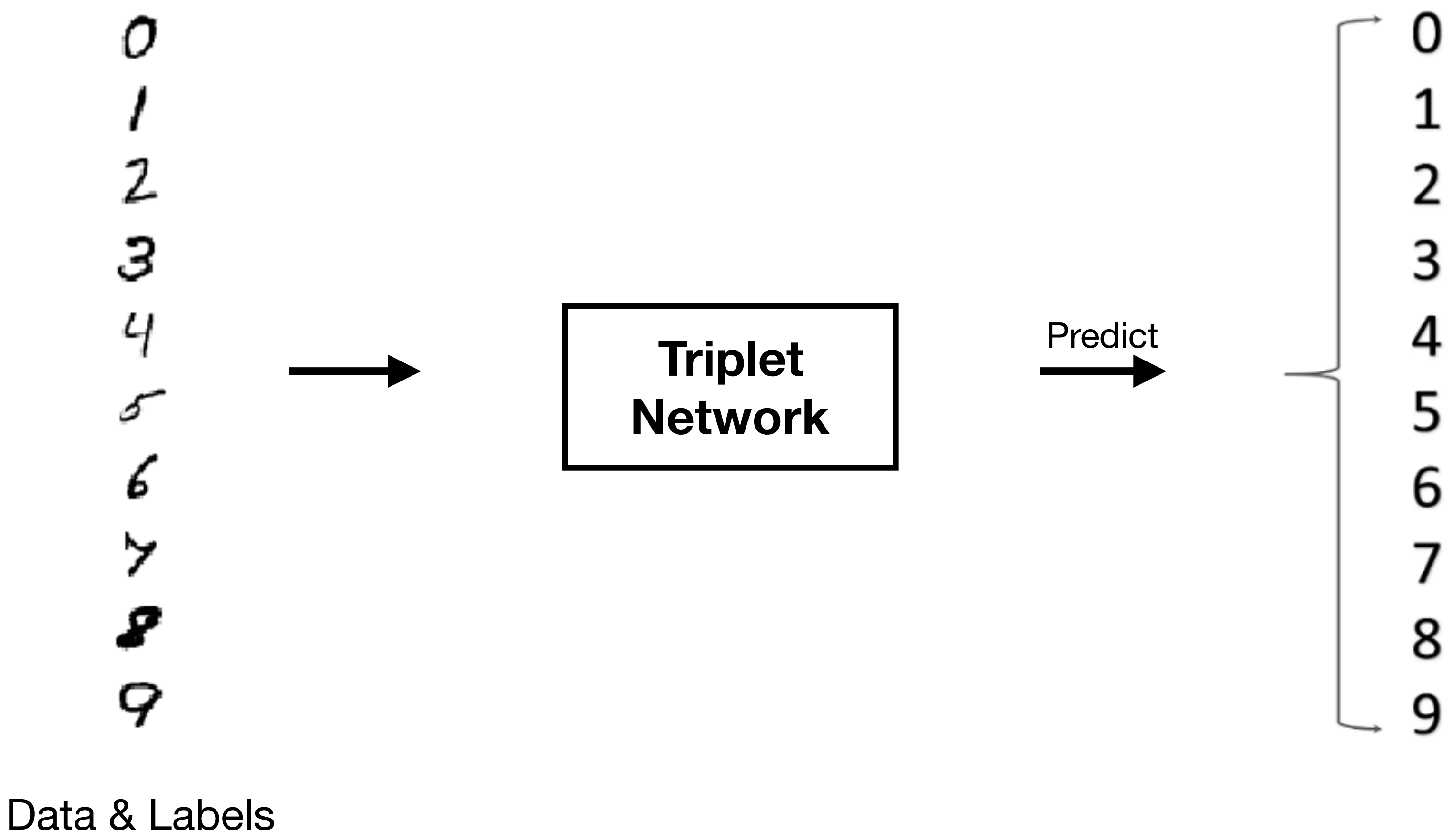
- General approach
  - Purpose: classify the image with **large amount of labeled training data.**



Introduction

Our Method

- Goal: categorize the image with **only one labeled data per class**.
- Contribution: Triplet Network + Data Augmentation.



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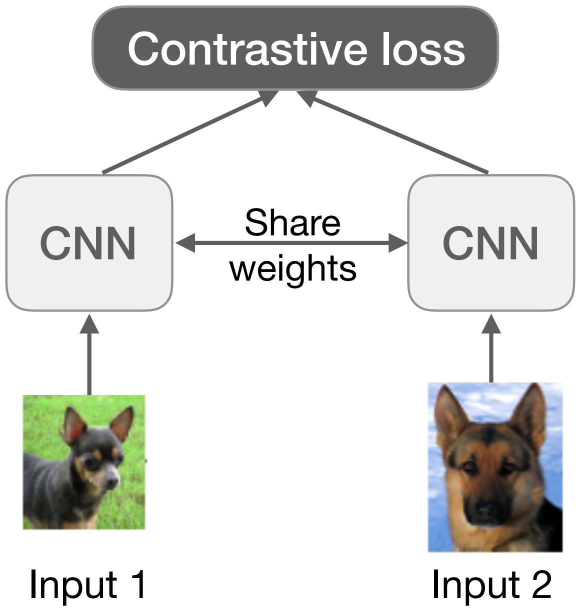
Related work

Convolutional Siamese Network [Koch+, 2015]

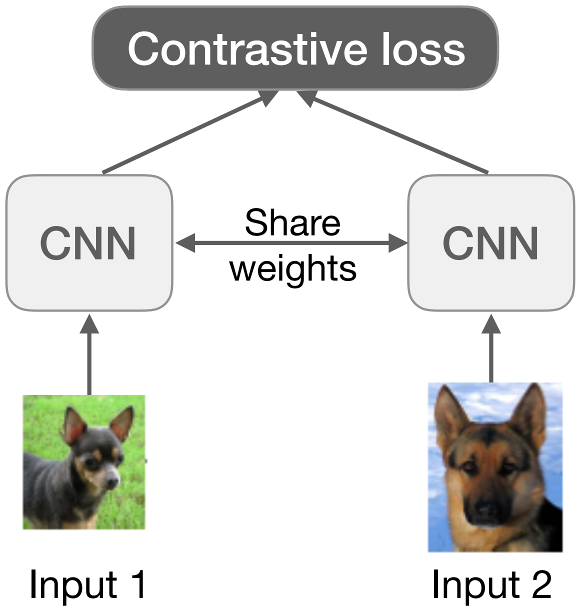
- **Architecture**
  - Learn **similarity** between two inputs.
  - 2 identical neural networks (same weights).
  - Optimized by a **contrastive loss**.



Related work

Convolutional Siamese Network [Koch+, 2015]

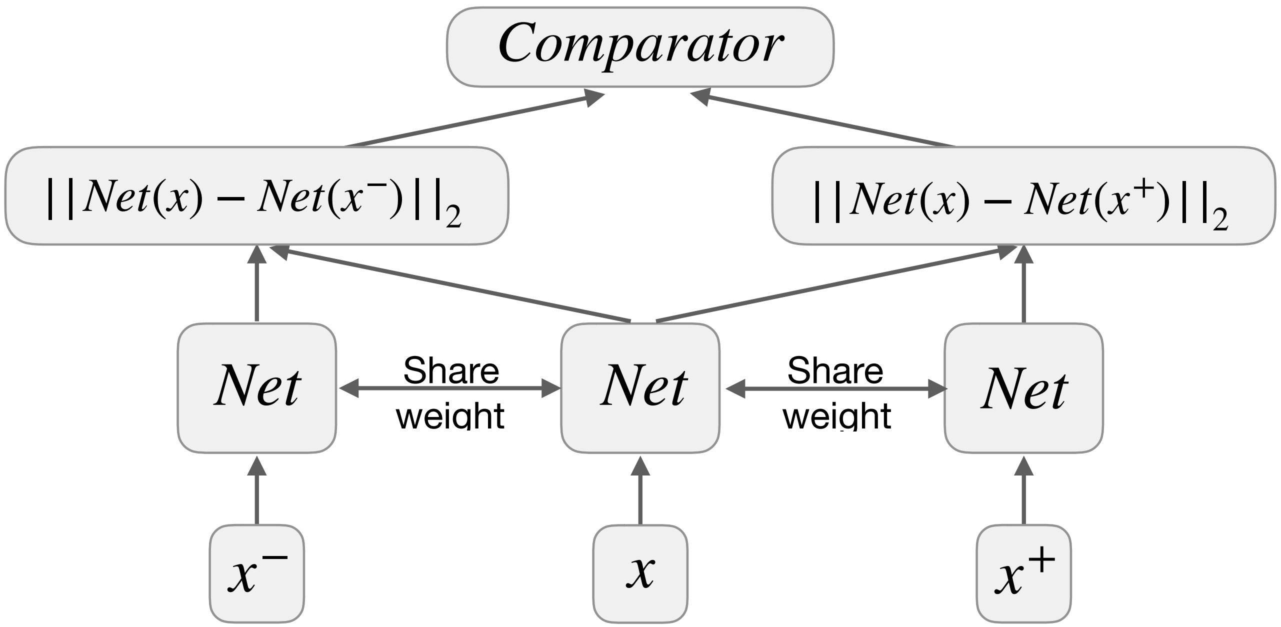
- **Contrastive loss function**
  - Evaluate how well the network is distinguishing a given pair of images.
  - Keep the samples belonging the same class close to each other and separate the dissimilar samples.



Related work

Triplet Network [Hoffer+, 2015]

- Aim to learn useful representations by distance comparisons.
- Comprised of 3 instances of the same feedforward network (with shared parameters).
- Output 2 intermediate values - the L2 distance.



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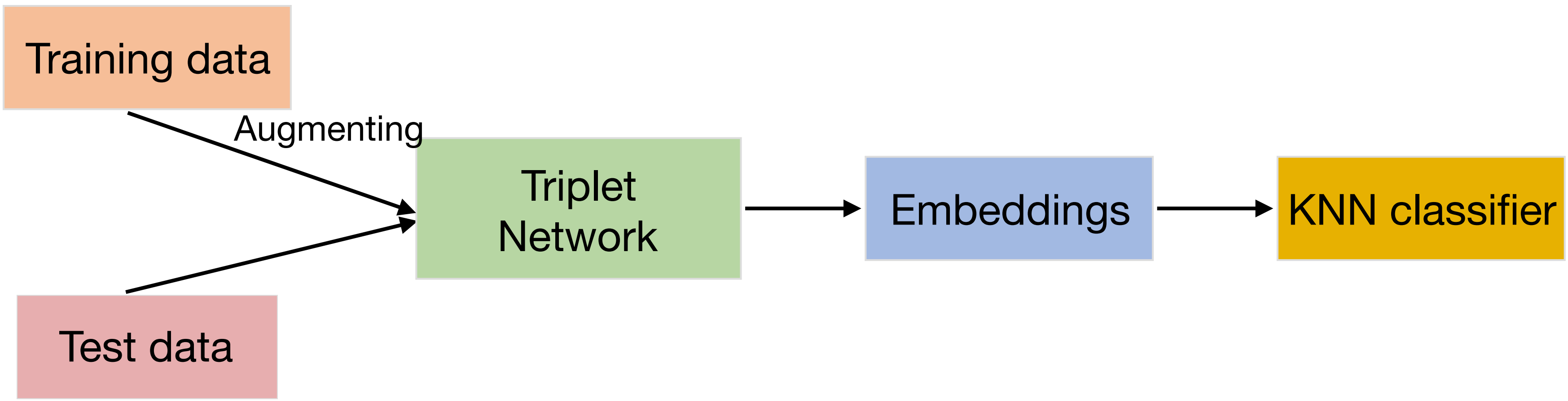
Method

Procedure

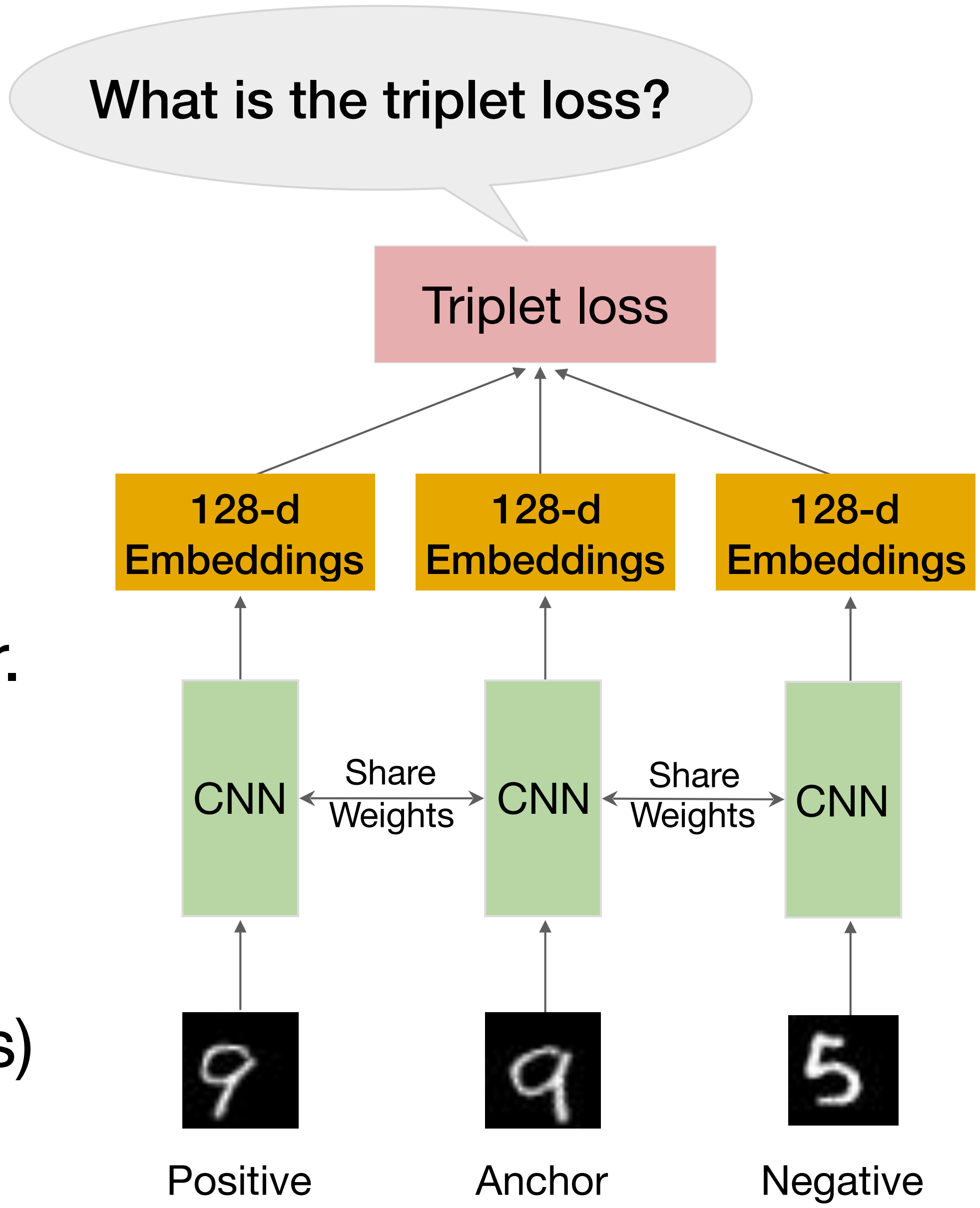
- Triplet Network
- Triplet Loss function
  - FaceNet (Schroff et al., 2015)
- kNN classifier
  - Make the prediction by using the feature vectors of training and test points.



Method

Triplet Network

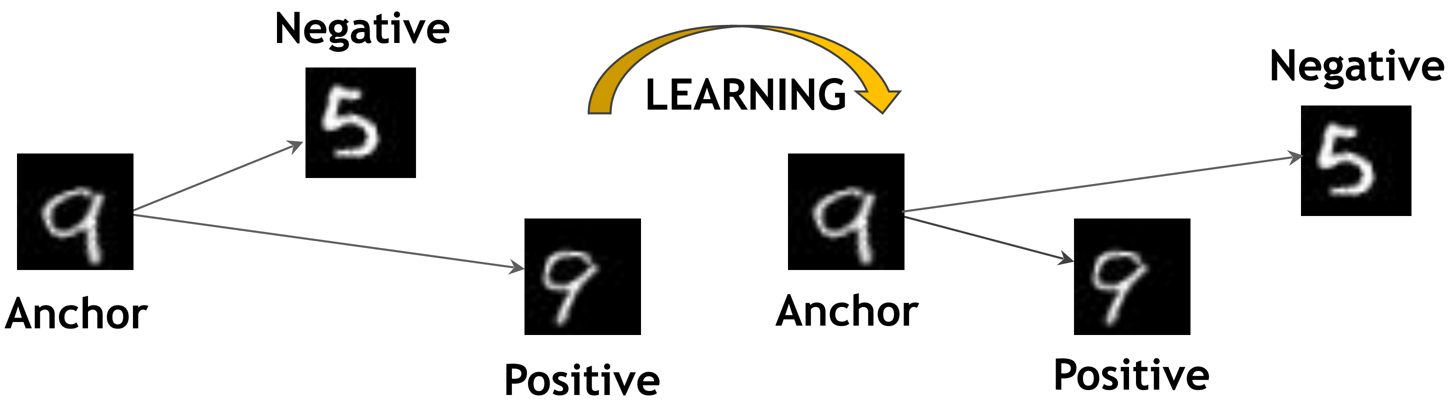
- 3 inputs:
  - **Anchor**: sample from dataset.
  - **Positive**: a sample from same class as the Anchor.
  - **Negative**: a sample from different class than the Anchor.
- CNN model (shared weights)
  - Input shape: (28, 28, 1)
  - Output shape: 128
- Triplet Loss function



Method

Triplet Loss

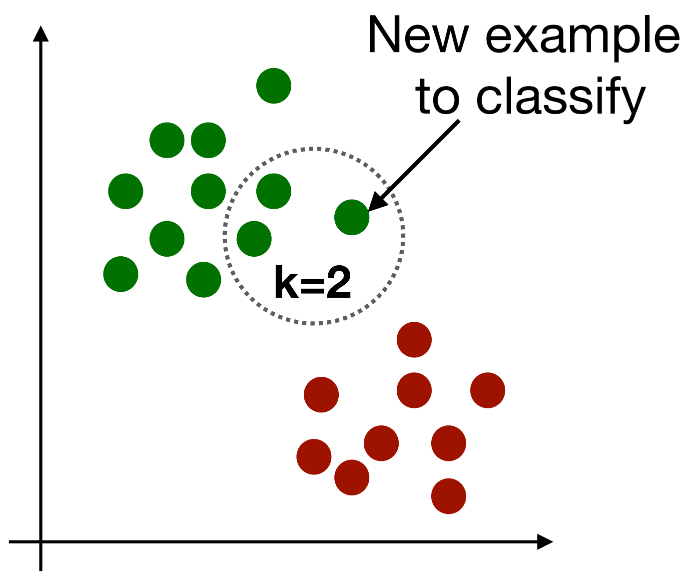
- $L = max(d(x_a, x_p) - d(x_a, x_n) + \alpha, 0)$
- where α is a margin that is enforced between positive and negative pairs.
- Minimizes the distance between the ***anchor*** and the ***positive***.
- Maximizes the distance between the ***anchor*** and the ***negative.***



Method

k-Nearest Neighbors

- One of the simplest way to perform classification.
- Most kNN classifiers use Euclidean distances (also known as L2-norm distance) to measure the similarities between the instances which are represented as vector inputs.



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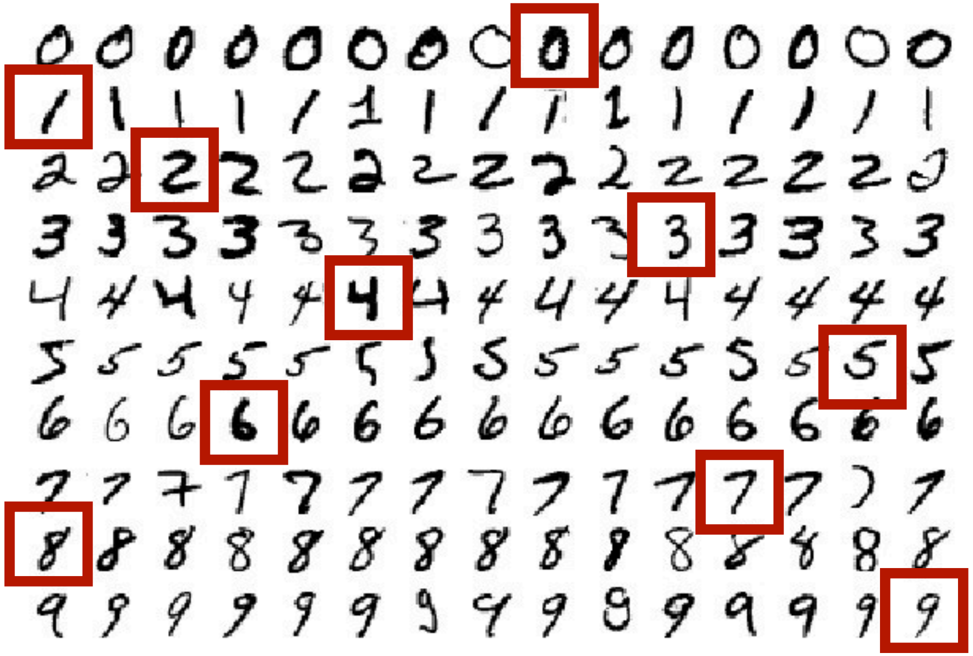
Experiments

How do we choose the data?

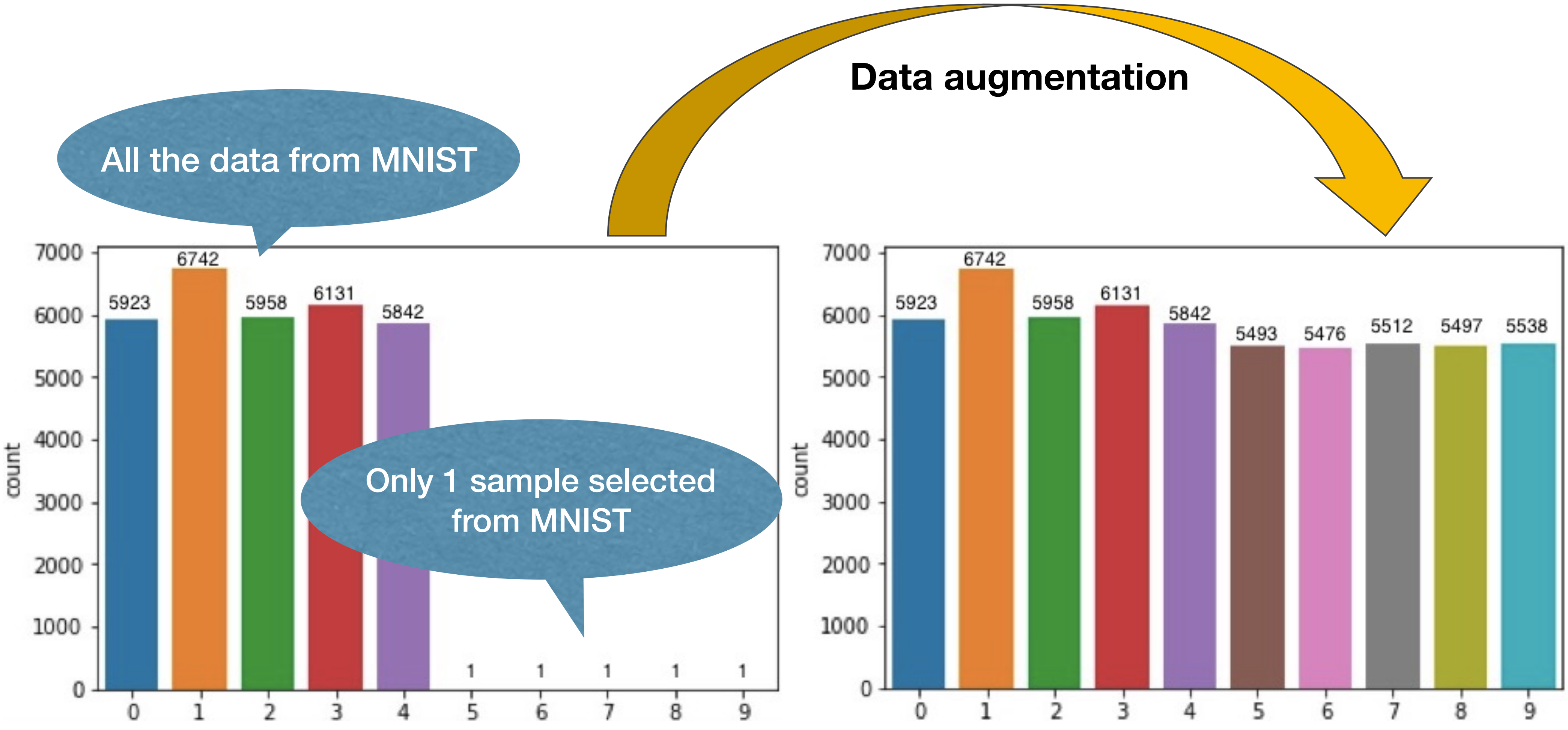
- **MNIST dataset**
  - A large database of handwritten digits widely used in the field of machine learning.
  - We randomly select 1 sample from each class in the MNIST dataset.



Experiments

How do we generate the dataset?

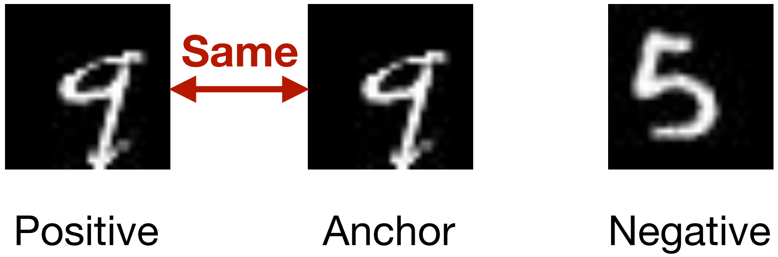
- Our initial dataset.
- Our augmented dataset.



Experiments

How do we select triplets?

- Our initial dataset.



- Our augmented dataset.

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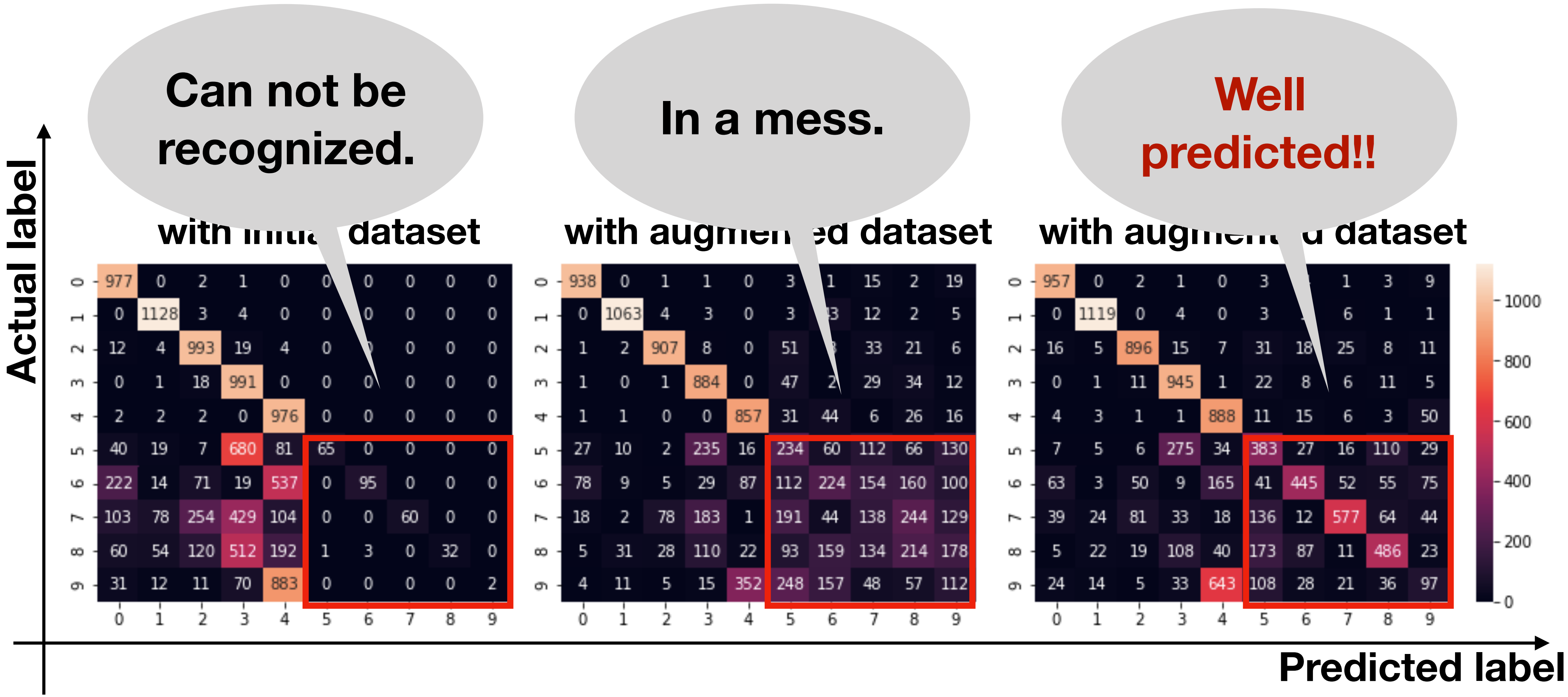
Results

Method (dataset)	Accuracy					
	5	6	7	8	9	Average
TripletNN (not Agumented)	14%	18%	11%	6%	0%	9.8%
CNN (Augmented)	25%	26%	16%	24%	13%	20.8%
TripletNN (Augmented)	**42%**	**56%**	**66%**	**56%**	**14%**	**46.8%**



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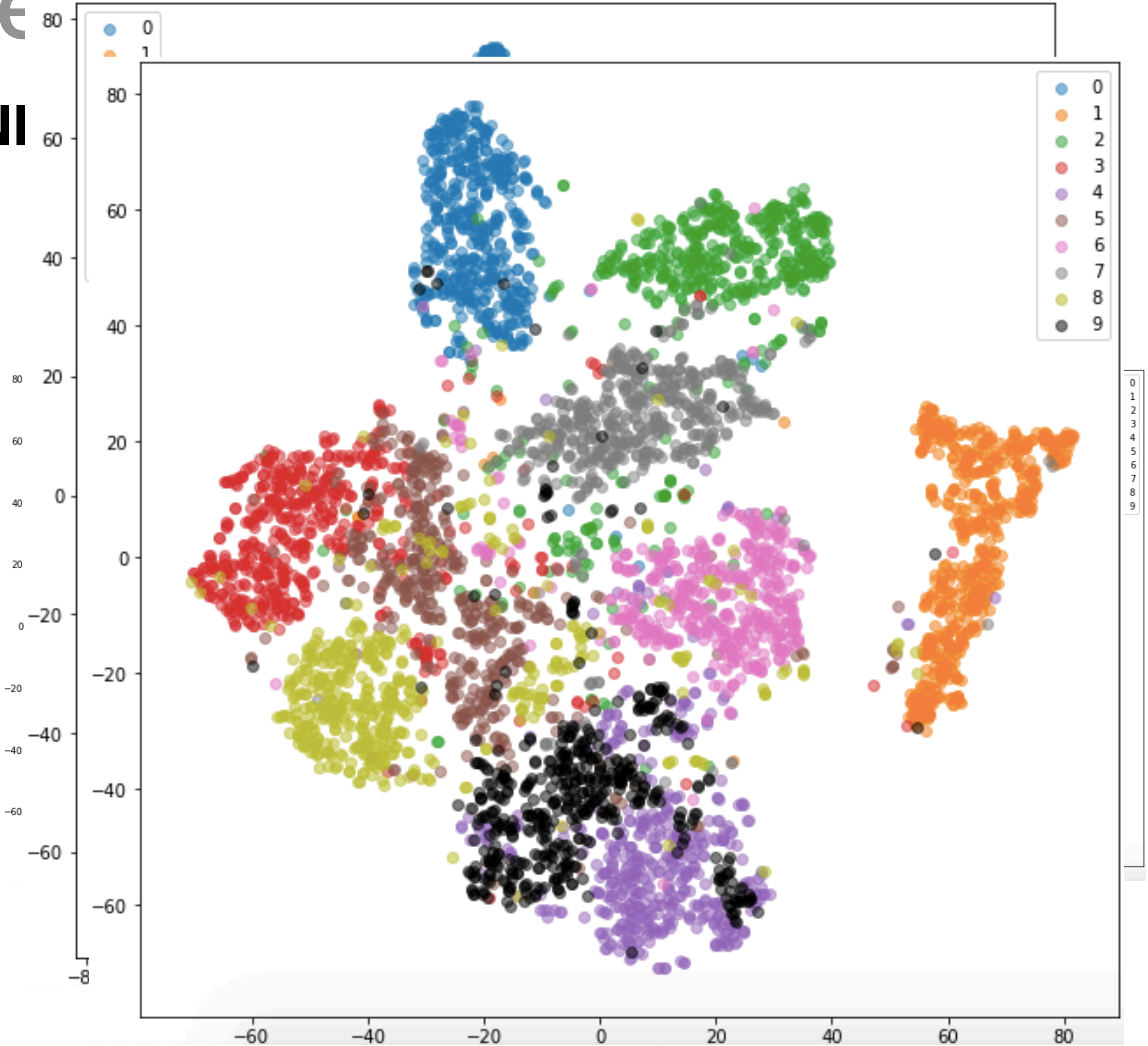

Conclusion

- Triplet neural network make sense in this experiment, the accuracy shows better than CNN model in one-shot learning problem.

- This study indicates that the benefits gained from data augmentation also work well on one-shot learning problem.

Future work

- Work on other much larger and complex datasets for one-shot classification, (e.g. Fashion MNIST, Omniglot, Mini-ImageNet), to validate whether our method is resultful.

- Find more effective approaches and investigate other techniques based on metric learning or meta learning, or combine other method such as Adversarial Generalized Model.

Thank you!

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