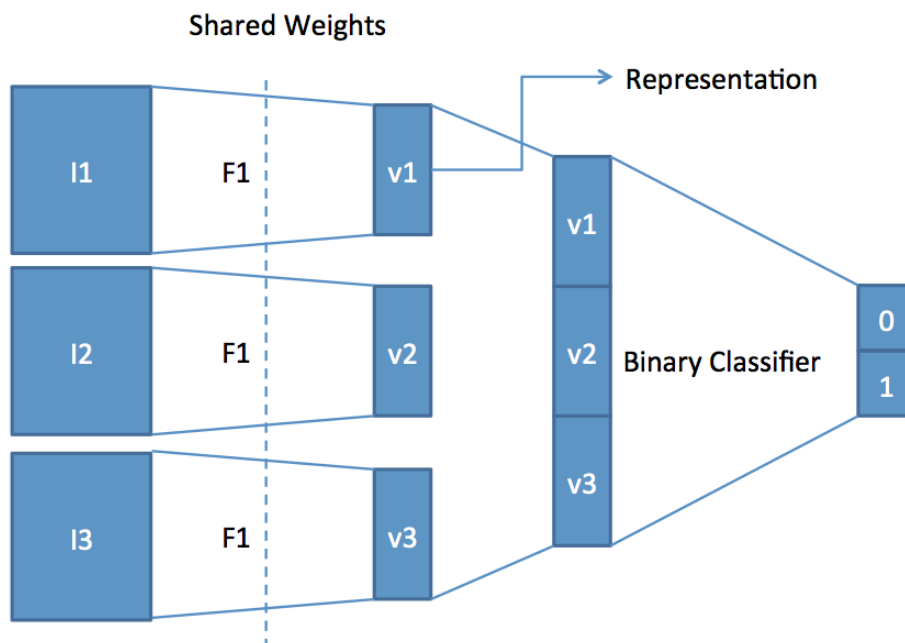


Learning Representations via Weak Supervision Using Deep Learning.

Deep neural networks have achieved tremendous success in some classification tasks in vision, videos and natural languages. Many research works have attributed this success to deep neural network's capability of extracting features in a hierarchical manner. While some recent work cast doubt on this, claiming that deep neural networks can only learn some superficial features which have high correlation with labels.

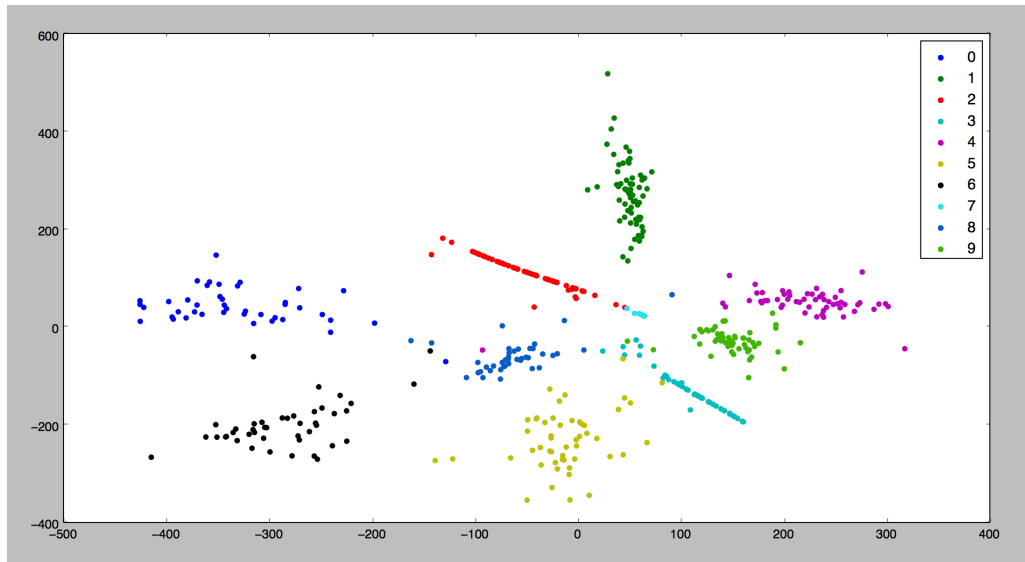
In this project, we will look into this problem in a different point of view. Instead of directly training a neural network model for classification, we need three data instances at a time (denoted as I_1, I_2 and I_3). We employ an identical neural network F_1 to mapping these three instances into three feature vectors v_1, v_2 and v_3 , then concatenate them as the input of a subsequent binary classifier F_2 . We only tell the network which one of I_1 and I_2 is more similar to I_3 . For example, we can let I_1, I_3 be instances of the same category, different from I_2 , and claim that I_1 is more similar to I_3 compared with I_2 . We train neural network F_1 and F_2 jointly in an end-to-end manner.

We can call this *triplet learning model*. In real life applications, the supervision of comparison may be made by humans. For example, comparisons between different painting styles. We want to use this model to learn implicit categories behind such comparison as well as try to compare two objects quantitatively.



Ideally, we expect neural network F_1 maps the incoming instances into clusters, where one cluster corresponds to one label. Preliminary experiments shows that this works fine for MNIST data, but with carefully fined hyper parameters. (plots below) Note that the (only) supervision of this model is the relatively semantic similarity between a triplet tuple, we hope neural networks can reconstruct the true latent categories behind this weak supervision by representation learning.

Your task in this project is to try similar ideas using different kinds of neural networks as F_1 on variant benchmarks. Analysis on the robustness and optimization scheme will be a bonus.



Key Words

Representation Learning, Neural Network

Requirements

- Proficient in python. Familiar with at least one deep learning package, such as tensorflow, pytorch, cntk and theano.
- Basic machine learning and optimization knowledge is necessary.
- Experience in training neural networks would be a plus.

Reference

1. Hoffer E, Ailon N. Deep metric learning using triplet network[C]//International Workshop on Similarity-Based Pattern Recognition. Springer, Cham, 2015: 84-92.
2. Jo J, Bengio Y. Measuring the tendency of CNNs to Learn Surface Statistical Regularities[J]. arXiv preprint arXiv:1711.11561, 2017.