1 Problem Statement

How can we use zero-shot and transfer learning to better denoise images?

2 Deep Learning Book

Relevant chapters from DLB [1]

- **7.7 Multitask Learning**
  - The model can generally be divided into two kinds of parts and associated parameters:
    1. Task-specific parameters (which only benefit the examples of their task to achieve good generalization). These are the upper layers of the neural network in figure 7.2
    2. Generic parameters, shared across all the tasks (which benefit from the pooled data of all the tasks). These are the lower layers of the neural network in figure 7.2
  - From the point of view of deep learning, the underlying prior belief is the following: *among the factors that explain the variations observed in the data associated with the different tasks, some are shared across two or more tasks.*
- **7.13 Adversarial Training**
  - Adversarial examples also provide a means of accomplishing semi-supervised learning
  - Approach encourages the classifier to learn a function that is robust to small changes anywhere along the manifold where the unlabeled data lie
  - The assumption motivating this approach is that different classes usually lie on the disconnected manifolds, and a small perturbation should not be able to jump from one class manifold to another class manifold
- **15 Representation Learning**
  - Training with supervised learning techniques on the labeled subset often results in severe overfitting
  - Semi-supervised learning offers the chance to resolve this overfitting problem by also learning from the unlabeled data
  - Specifically, we can learn good representations for the unlabeled data, and then use these representations to solve the supervised learning task
- **15.2 Transfer Learning and Domain Adaptation**

- The learner must perform two or more different tasks, but we assume that many of the factors that explain the variations in P_1 are relevant to the variations that need to be captured for learning P_2
- Typically understood in a supervised learning context, where the input is the same but the target may be of a different nature
- Two extreme forms of transfer learning are *one-shot learning* and *zerof-shot learning*, sometimes also called *zero-data learning*.
  * Only one labeled example of the transfer task is given for one-shot learning, while no labeled examples are given at all for the zero-shot learning task
  * Zero-data learning [2] and zero-shot learning [3, 4]

3 Papers

3.1 Zero-Shot Learning

- CleanNet: Transfer Learning for Scalable Image Classifier Training With Label Noise [5]
  - In this paper, we study the problem of learning image classification models with label noise. Existing approaches depending on human supervision are generally not scalable as manually identifying correct or incorrect labels is time-consuming, whereas approaches not relying on human supervision are scalable but less effective. To reduce the amount of human supervision for label noise cleaning, we introduce CleanNet, a joint neural embedding network, which only requires a fraction of the classes being manually verified to provide the knowledge of label noise that can be transferred to other classes. We further integrate CleanNet and conventional convolutional neural network classifier into one framework for image classification learning. We demonstrate the effectiveness of the proposed algorithm on both of the label noise detection task and the image classification on noisy data task on several large-scale datasets. Experimental results show that CleanNet can reduce label noise detection error rate on held-out classes where no human supervision available by 41.5% compared to current weakly supervised methods. It also achieves 47% of the performance gain of verifying all images with only 3.2% images verified on an image classification task. Source code and dataset will be available at kuanghuei.github.io/CleanNetProject.

References

[1] Ian Goodfellow, Yoshua Bengio, and Aaron Courville. *Deep Learning*. MIT Press, 2016. http://www.deeplearningbook.org.

[2] Hugo Larochelle and Y Bengio. Classification using discriminative restricted boltzmann machines. pages 536–543, 01 2008.

[3] Mark Palatucci, Dean Pomerleau, Geoffrey Hinton, and Tom M. Mitchell. Zero-shot learning with semantic output codes. In *Proceedings of the 22Nd International Conference on Neural Information Processing Systems*, NIPS'09, pages 1410–1418, USA, 2009. Curran Associates Inc.

[4] Richard Socher, Milind Ganjoo, Hamsa Sridhar, Osbert Bastani, Christopher D. Manning, and Andrew Y. Ng. Zero-shot learning through cross-modal transfer, 2013.

[5] Kuang-Huei Lee, Xiaodong He, Lei Zhang, and Linjun Yang. Cleannet: Transfer learning for scalable image classifier training with label noise. In *The IEEE Conference on Computer Vision and Pattern Recognition (CVPR)*, June 2018.