Generative Adversarial Networks

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Abstract

We provide an overview of Generative Adversarial Networks as a class of generative models for image generation, and discuss how they can be used towards the task of automatic image colorization. We first give a brief overview of Deep Learning and the recent advances in generative models. We then discuss several varients of Generative Adversarial Networks, the problems they pose during training, and theoretical methods towards stabalizing training.

1 Introduction

Deep learning has recently shown impressive results towards various problems in multiple domains such as speech recognition, image classification, image segmentation, and reinforcement learning []. Until recently, much of the focus was towards discriminative models, which aims to map a high-dimensional input, such as an image, to a class label. Deep generative models, such as Deep Botlzmann Machines and Deep Belief Networks, have not had the same level of success. Generative Adversarial Networks (GANs)[1] are a class of generative models that have shown great success in generatig realistic images. Despite their success, they are known to be very difficult to train, and are extremely sensitive to modifications. For this reason it is not yet straightforward to directly apply them towards a different problem.

Since their introduction in 2014, there have been several large contributions made towards stabalizing and understanding the training process of GANs. We discuss and compare four different objective functions used for training GANs:

- Classification loss
- Least Squares loss
- Energy loss
- Wasserstein

We provide a background on deep learning in Section 2, and in Section 3 discuss the varients of GANs mentioned above. Section 4 demonstrates these varients on the task of automatically colorizing grayscale images. The Appendix provides further results from our experiments.

2 Background

2.1 Deep Learning

2.2 Convolutional Neural Networks

2.3 Generative Models

Much of the early success in deep learning was geared towards discriminative models.

3 Generative Adversarial Networks

3.1 Deep Convolutional GANs

3.2 Conditional Generative Adversarial Networks

3.3 Least Squares GANs

3.4 Energy-Based GANs

3.5 Wasserstein GANs

4 Colorization

We now show how adversarial networks can be used for generating a plausible color version of a grayscale image. The problem is set up as a cGAN, where the generator and descriminator are both conditioned on the grayscale image.

[1] Graves, Alex, and Navdeep Jaitly. "Towards End-To-End Speech Recognition with Recurrent Neural Networks." ICML. Vol. 14. 2014. [2] Goodfellow, Ian, Yoshua Bengio, and Aaron Courville. Deep learning. MIT Press, 2016.

A Appendix

Here we show