Multiple Generative Adversarial Nets

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***Abstract*—Triple Generative Adversarial Nets (TGANs), which is based on Generative Adversarial Nets (GANs), have gained great success in image generation and semi-supervised learning (SSL). By adding a new role – classifier, TGANs make the generator, the classifier and the discrimator simultaneously achieve the state-of-art results among deep generative models. We guess that if we add more roles into GANs, there can be significant improvement on the quality of image generation and the accuracy of image identification. To verify this guess, we present multiple generative adversarial net (MGAN), which consists of n players – a generator, a discriminator, a classifier C_1 , a classifier C_2 of classifier C_1, a classifier C_3 of classifier C_2, $\cdots$, a classifier C_{n-2} of classifier C_{n-3}. The generator and the classifier characterize the conditional distributions between images and labels, and the discriminator solely focuses on identifying fake image-label pairs. Our results on various datasets demostrate that MGANs have higher quality of image generation and higher accuracy of image identification.**

***Index Terms*—Generative Adversarial Nets, Artificial Intelligence, Deep Learning**

I. Introduction

Recently, significant progress has been made on generating realistic images based on Generative Adversarial Nets (GANs). GAN is formulated as a two-player game, where the generator G takes a random noise z as input and produces sample $G(z)$ in the data space while the discriminator D identifies whether a certain sample comes from the true data distribution $p(x)$ or the generator. Both G and D are parameterized as deep neural networks and the training procedure is to solve a minimax problem:

$$\min_G \max_D U(D,G) = E_{x\sim p(x)}[\log(D(x))] + E_{z\sim p_z(z)}[\log(1-D(G(z)))]$$

We attempt to add more roles to the GANs. We introduce $n-1$ conditional networks – $n-2$ classifiers and a generator to generate pseudo labels given real data and pseudo data given real labels, respectively. To justify the quality of the samples from the conditional networks, we define a single discriminator network which can distinguish whether a data-label pair is from the real labeled dataset or not. The resulting model is called Multi-GAN because it has n roles and $n-1$ conditional networks between them.

Overall, our main contribution is getting higher quality of image generation and higher accuracy of image identification.