

GANs are not likelihood based models



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OpenAI

Comparing GANs to likelihood-based generative models is not apples-to-apples, since they are optimized towards different objectives. The objectives present different trade-offs.

For the same parameter budget, GANs can produce much sharper images, since the objective allows the model to assign zero probability to all training points, as long as the samples that are generated look realistic to the discriminator.

Contrary to your typical GAN objective, a fundamental property of the log-likelihood objective is that after training, every training point is likely under the generative model. As long as you don't overfit, which is easy to check against, every new image is also likely under the model (assuming i.i.d. data).

In case of latent-variable models of images such as Glow, this means that the latent space can meaningfully represent new images. This also means that you can do things like manipulations of new images in a latent space. ProGAN and SAGAN won't allow you to do this, at least not without serious modifications.

Training Normalizing Flows

Density evaluation and training is based on change of variable formula

$$p_X(\mathbf{x}) = p_Z(T_\theta(\mathbf{x})) \left| \det \frac{\partial T_\theta(\mathbf{x})}{\partial \mathbf{x}} \right|$$