Perfomance of Generative Adversarial Networks

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23th Oct 2019

TVE17MCA054
MCA CET
S5 : 51

- Comparing with CelebA-HQ with FFHQ based on Frechet inception distances (FID) , a great improvement happens

Inception Score (IS)

IS uses two criteria in measuring the performance of GAN:

- The quality of the generated images and
- their diversity.

Inception Score (IS)

- Entropy
- If the value of a random variable x is highly predictable, it has low entropy.
- In GAN, we want the conditional probability $P(y|x)$ to be highly predictable (low entropy).
- i.e. given an image, we should know the object type easily.

- So we use an INCEPTION NETWORK to classify the generated images and predict P(y|x) — where y is the label and x is the generated data.

$$\text{IS}(G) = \exp\left(\mathbb{E}_{\mathbf{x} \sim p_a} D_{KL}(\, p(y|\mathbf{x}) \,\|\, p(y)\,)\right),$$

- Misrepresent the performance if it only generates one image per class. p(y) will still be uniform even though the diversity is low

Fréchet Inception Distance (FID)

- Use the Inception network to extract features from an intermediate layer.
- Model the data distribution for these features using a multivariate Gaussian distribution with mean μ and covariance .
- FID between the real images x and generated images g:

$$\mathrm{FID}(x, g) = \|\mu_x - \mu_g\|_2^2 + \mathrm{Tr}(\Sigma_x + \Sigma_g - 2(\Sigma_x \Sigma_g)^{\frac{1}{2}}),$$

where Tr sums up all the diagonal elements.

Fréchet Inception Distance (FID)

Lower FID values mean better image quality and diversity