

Performance 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.

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

- 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 Σ .
- FID between the real images x and generated images g :

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

where Tr sums up all the diagonal elements.

Fréchet Inception Distance (FID)

Lower FID values mean better image quality and diversity.