The Computer Vision Training Course MIPT

Milestones for object detection

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Abstract

In this report, I summarize generative adversarial networks problems and some applications of this neural network. GANs actively implement in modern applications. There are a lot of unresolved problems with this technology. That is why the interest in GANs is on the rise.

Importance

In a 2016 seminar, Yann LeCun described GANs as "the coolest idea in machine learning in the last twenty years".[1] This technology is similar to the human learning process. The AI algorithms that have a good performance. The main benefit of GANs is that this kind of networks caused a breakthrough in some cases of computer vision. There are some versions of the algorithm can be classified as unsupervised learning. A developer does not need data labels to teach this network. For example, you need just photos that are taken on camera to generate an image with properties related to data. GANs have also proven useful for semi-supervised learning,[2] fully supervised learning,[3] and reinforcement learning.[4] This diversity allows you to increase accuracy and find other places of application.

Application

GAN is invented by Ian Goodfellow and his colleagues in 2014. There are a lot of applications that was invented since 2014. For example, image reconstruction including image restoration and denoising. It is a challenging problem in the field of image computing.[5] GAN helps in pose guided person image generation, to create anime characters. CycleGAN transform images from one domain to another domain. It is used in commercial applications like Prisma. Some GANs can improve image clarity. It is called super-resolution. This kind of neural networks is used in Huawei phones to reduce camera costs and improve the quality of the pictures. A lot of products of ABBYY contain these AI technologies. GANs are used to create bots that compete with humans in games like Go. For example, the neural network in AlphaGo Zero is trained from games of self-play by a novel reinforcement learning algorithm.

There are not a lot of commercial applications because it is new technology that provides new opportunities for which there is a demand. Nowadays we can see the rapid development of technology. But there are some GAN problems that stop the development of technology.

Problems

The first problem is learning difficulties. It is really hard to train GANs. The most common problem is sensitivity to change hyperparameters. It requires a lot of effort and time of a developer. There are a lot of papers that describe experiments with ways to improve algorithm convergence. But there is not any evidence with mathematics. It is just practical guesses.

The second problem is vanishing and exploding gradients. If discriminator becomes better than the generator, the learning process of generator stops. That is why smaller gradients should come in the discriminator than to generator. It is one of the ways to improve the classical algorithm.

The third problem is the metrics. There are no good enough metrics to analyse the quality of discriminator and generator. That is why sometimes connect the third component to the architecture of GAN -- pre-trained neural network. It can easily detect the wrong way of learning and be metric for a GAN.

Conclusion

The generative adversarial network is a promising technology. That has a lot of ways of development.

Related Papers and Links

[1] LeCun, Yann. "RL Seminar: The Next Frontier in AI: Unsupervised Learning".

[2] Salimans, Tim; Goodfellow, Ian; Zaremba, Wojciech; Cheung, Vicki; Radford, Alec; Chen, Xi (2016). "Improved Techniques for Training GANs".

[3] Isola, Phillip; Zhu, Jun-Yan; Zhou, Tinghui; Efros, Alexei (2017). "Image-to-Image Translation with Conditional Adversarial Nets".

[4] Ho, Jonathon; Ermon, Stefano (2016). "Generative Adversarial Imitation Learning"

[5] Longfei Liu, Sheng Li∗, Yisong Chen, Guoping Wang (2018). “ X-GANs: Image Reconstruction Made Easy for Extreme Cases”.