

基于生成式对抗神经网络的图像数据扩充

摘 要

神经网络的有效训练需要大量的数据。在低数据状态下,参数的确定不足,学习网络的泛化能力较差。数据增强通过更有效地使用现有数据来缓解这一问题。然而,标准数据扩充只产生有限的可信替代数据。思考到有概率会生成更广阔的扩充集,因此通过设计了生成网络来对其进行了数据扩充并对该网络进行了训练。此网络的基础是图像的条件生成式对抗网络,通过训练集来获取数据,学习收获任意数据集,同时将其归类为同一类的其他数据集。因为此种生成过程并不依靠于本身的类,所以能够使用在新的不可见的数据集中。

本文以生成式对抗神经网络(Generative Adversarial Networks, GAN)为基础,通过对 MINIST 数据集和人脸数据集的学习处理,分别搭建图像生成模型,以实现特定图像数据的随机生成数据扩充的任务。首先介绍本文的课题背景和研究意义,阐述了深度学习以及 GAN 的发展历程和国内外研究现状。同时对数据增强进行了详细的介绍。此外对本文使用到的一些相关的技术或者运算方法进行介绍:卷积算法、批归一化、各类激活函数、网络的架构、GAN 模型等做了较为详细的介绍。其次利用深度学习框架 tensorflow 平台验证了本文的深度卷积对抗生成网络(Deep Convolutional Generative Adversarial Network, DCGAN),通过对比实验表明该网络除了可以生成较高质量的图像以外,还能够增加用生成的图像训练的网络分类识别的准确率。此外,也对特定的参数进行了相应的调整优化一定范围内减少 DCGAN 网络在训练过程中的损失函数曲线产生比较大的波动或者出现离散的情况。

GAN 拥有着能够生成大量样本数据的能力,对于随机的输入可以生成多种形式的数,可以解决实际应用中对数据不足、有特定要求的样本等问题。对深度学习以及人工智能领域的发展都有重要的意义。

关键词: 深度学习, 数据增强, 生成对抗网络, 卷积神经网络, 深度卷积对抗生成网络

ABSTRACT

Effective training of neural networks requires much data. In the low-data regime, parameters are underdetermined, and learnt networks generalise poorly. Data Augmentation alleviates this by using existing data more effectively. However standard data augmentation produces only limited plausible alternative data. Given there is potential to generate a much broader set of augmentations, we design and train a generative model to do data augmentation. The model, based on image conditional Generative Adversarial Networks, takes data from a source domain and learns to take any data item and generalise it to generate other within-class data items. As this generative process does not depend on the classes themselves, it can be applied to novel unseen classes of data.

In this paper, based on the generative neural network, through the learning and processing of MINIST dataset and face dataset, image generation models are built respectively to achieve the task of random generation data expansion for specific image data. Firstly, it introduces the background and research significance of this paper, and expounds the development of deep learning and Gan, as well as the research status at home and abroad. At the same time, data enhancement is introduced in detail. In addition, some related technologies or operation methods used in this paper are introduced in detail: convolution algorithm, batch normalization, various activation functions, network architecture, Gan model, etc. Secondly, the deep convolutional generative advanced network (dcgan) of this paper is validated by tensorflow platform, which is a deep learning framework. The comparative experiments show that the network can not only generate high-quality images, but also increase the accuracy of network classification and recognition trained by the generated images. In addition, the specific parameters are adjusted and optimized to reduce the loss function curve of dcgan network in the training process to produce large fluctuation or discrete situation.

Gan has the ability to generate a large number of sample data. For random input, it can generate a variety of forms of data. It can solve the problem of insufficient data and samples with specific requirements in practical applications. It is of great significance to the development of deep learning and artificial intelligence.

Keywords: Deep learning, Data Augmentation, Generative Adversarial Network , Deep Convolutional Generative Adversarial Network

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