Machine Learning II

Final Project Proposal

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Problem Selection and Research Objectives

Description of the Question

Combined with the knowledge of neural network learned in Machine Learning II, we hope to learn more in-depth and interesting knowledge on this basis. After investigation, Generative Adversarial Networks completely meets our requirements. As a new technology, GAN has been developing vigorously in recent two years. It is based on our familiar neural network such as multilayer perceptron (MLP) and convolutional neural network (CNN), but brings new vitality to machine learning.

Research Overview

We will first introduce the data, then concepts, algorithms, and structures of our models. We hope to give you a macro understanding of what theories and materials we are based on to complete this project. Then we'll explain each step of implement, the problem we encountered, and how to solve it. Finally, we will explain the reasons for the deficiency and the ideas for future improvement.

Related Material and Background Supportive

Generative Adversarial Networks (GAN) is a cutting-edge technique of deep neural networks, which was first come up by Ian Goodfellow in 2014. In 2016, Yann LeCun, who is one of the leading scientists in AI, described GAN as “the coolest idea in machine learning in the last twenty years.”

GAN is a very new stuff and has a promising future. Especially in last year (2018), GAN was developed with an exponential increment. In other words, it is almost an infant technology. Although it is really new, there are bunch of models named with the suffix __GAN, such as Conditional GAN, DCGAN, Cycle GAN, Stack GAN. Fortunately, we can catch up the development of GAN now. Actually, we’ve learned every single component in GAN if I break down it.

Data Selection and Overview

Data Source

https://www.kaggle.com/c/generative-dog-images

Our data comes from the Kaggle code competition, which was released in June 2019. Since the game has ended in August, the ranking of the leaderboard also has certain reference value for our own model progress.

The open source data consists of the image archive and the annotation archive. After further study, we believe that the subfolder name of the picture package can fully perform the task of label, so our model only USES the picture compression package.

Data Views:

Image/label illustration; shape; balance; resized images

	Dog Breed	Number of Observations
0	n02085620-Chihuahua	152
1	n02085782-Japanese_spaniel	185
2	n02085936-Maltese_dog	252
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.	.	.
.	.	.
117	n02115641-dingo	156
118	n02115913-dhole	150
119	n02116738-African_hunting_dog	169

Our dataset contains 20,579 images belonging to 120 dog breeds.

All images are colored with RGB channels, but the size is not fixed, and the proportion of dogs (main features) in the picture is not even. We can see that there are many pictures in which the complex background is the main body. And all we want to do is generate pictures of dogs. A large number of interference features will be the challenge of our study.

Initial Analysis and Procedure for Project

Deep Network Selection

We are going to design the GAN and CGAN for our dog images generation. We will be keeping trying other GAN method if necessary.

Framework to Implement the Network

GAN is a minimax problem, which is one of zero-sum non-cooperative games. Generator wants to maximize its performance, which works to generate images as real as possible to confuse the Discriminator. Discriminator wants to distinguish a mixture of original and generated images whether real or fake. In this game, zero-sum means if Generator is improved, then there must be an increased loss of Discriminator. Our aim is to find the lowest aggregate loss of them, where there is a Nash Equilibrium.

Reference materials

We will keep learning from the GAN-ZOO that includes vary kinds of GAN and publishes in 2017 by Avinash Hindupur; learn the content of GAN in Professor Lee's courses; reference codes from Professor Jafari's GitHub.

Evaluation Section

Since the goal of project is to generate the dog images. The results will be straightforward. However, during the training process, we will use loss functions such as binary cross entropy to track the training.

Summary and Further Development of the Project Section

The rationale behind the GAN is easy to understand. However, in practice, GANs are always unstable to train. In order to stabilize the training step of GANs. We will try some techniques for better results.

Schedule for Finishing the Project

Schedule	**goals**
October 25th – 31st	Data processing section and Target division
November 1th – 14th	Deep-Learning network selection and network design section
November 15th – 27th	Evaluation section and Improvement
November 28nd – December 3th	Summary and Presentation section

References

Avinash H. (2017). *The GAN Zoo*. GitHub. https://github.com/hindupuravinash/the-gan-zoo
Amir J.(2019). Deep-Learning. GitHub. https://github.com/amir-jafari/Deep-Learning
Hongyi, L. (2018). *GAN Lecture 1: Introduction*. YouTube. https://www.youtube.com/watch?v=DQNNMiAP5lw&list=PLJV_el3uVTsMq6JEFPW35BCiOQTsoqwNw&index=1
Kaggle Competition. (2019). *Generative Dog Images*. Kaggle. https://www.kaggle.com/c/generative-dog-images