Data Augmentation Using GAN to Improve Training of CNN Models

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Problem Selection and Research Objectives

1 Project Description

Generative adversarial networks, or GANs, are a class of machine learning systems that are used to generate new data given a data set, with the same statistical properties. Our work aims to display the effectiveness of new data generation as a form of image augmentation technique to improve the predictive performance of a convolutional neural network. Our work will be demonstrated with and without the synthetic image augmentation, for comparative purposes.

2. Research Overview

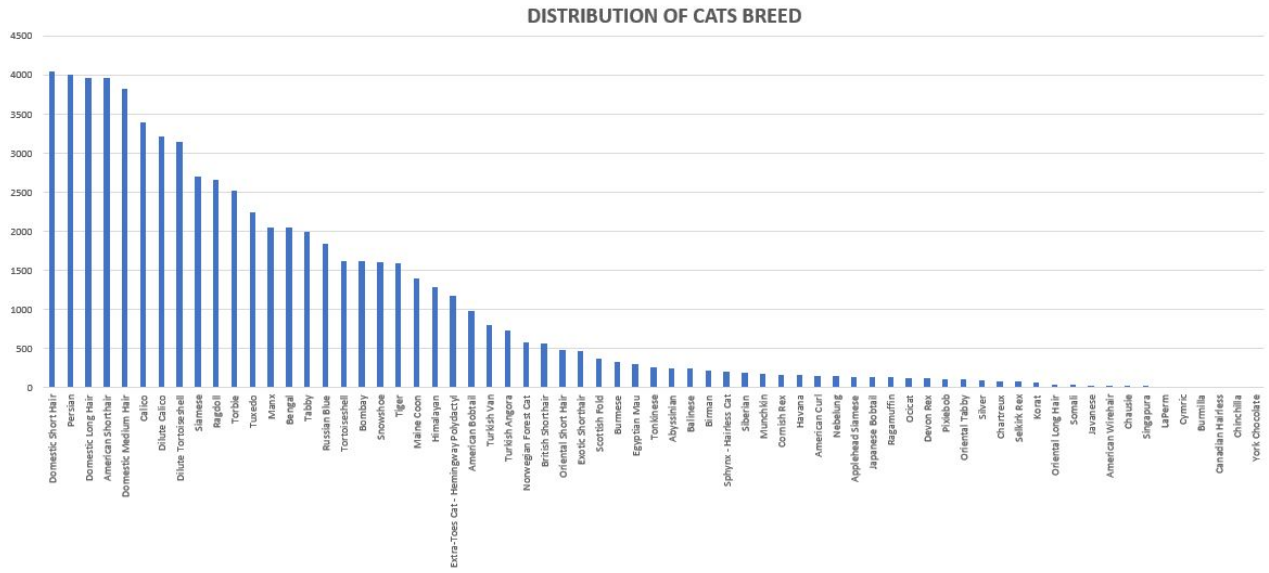
We will first introduce the data, then concepts, algorithms, and structures of our models. We hope to give you a macro understanding of what theories and materials we are based on to complete this project. Then we'll explain each step of implement, the problem we encountered, and how to solve it. Finally,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

3. Related Material and Background Supportive

We will be approaching this problem with our own variation of implementation of the technique and methodology first introduced in a paper by Frid-Adar et al. 2018 “GAN-based Synthetic medical Image Augmentation for Increased CNN Performance in Liver Lesion Classification” [1].
We will first describe and prepare our data to fit with the scope of our project. Thereafter, we will experiment with training our network before moving onto exploring the utilization of other pre-trained CNN models – all without the use of synthetic data. We will note the results before we proceed with training our Conditional Generative Adversarial Network, CGAN and then training the same CNN models with the use of generated data from the CGAN. We will then compare these results with the previously noted results and discuss our results.

4 Data

Our dataset contains 67,145 images belonging to 37 cat breeds. All images are colored with RGB channels, but the size is not fixed, and the proportion of cats (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 to identify the cat breed . A large number of interference features will be the challenge of our study. While the amount of data is not too small, there are too many labels, and the data for each category is not significant when evenly distributed. To visualize the data balance below bar graph to show the data distribution.



5. Initial Analysis and Procedure for Project

Deep Network Selection

We are going to use pre trained network with different techniques for comparative study and promote CGAN for our Cat images generation.

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.

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 29th – 31st POC on Datasets

November 01st – 24th Deep-Learning network selection and
network design section

November 25th – 30th Evaluation section and Improvement

December 01st – 07th Summary and Presentation section

References

[1] Frid-Adar et al. “GAN-based Synthetic Medical Image Augmentation for increased CNN Performance in Liver Lesion Classification”, 2018. Available at: https://arxiv.org/abs/1803.01229 [Accessed 061219]

[2] Alec Radford, Luke Metz, Soumith Chintala. “Unsupervised Representation Learning with Deep Convolutional Generative Adversarial Networks”, 2015. Available at: https://arxiv.org/abs/1511.06434 [Accessed 061219].

[3] Skin Cancer MNIST: HAM10000. Available at, along with detailed data source and licensing: https://www.kaggle.com/kmader/skin-cancer-mnist-ham10000 [Accessed 061219].